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DECEMBER

THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

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Mandibulomaxillary Relations—*Tench*
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FLORISTAN AGUILAR, Madrid, Spain
President of the Fédération Dentaire Internationale

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Original Communications

VINCENT'S INFECTION—ACUTE AND CHRONIC*

By F. J. REICHMANN, D.D.S., Oklahoma City, Oklahoma

TO pose as the "last word," to become a sensational hawker of so-called scientific truths, laying down rules that will not stand reasoning, is the field of the demagogue, whether he be political or professional. Therefore I cannot say, like one of our number in the profession, who is now riding on the crest of popularity on account of his eloquence and wonderful ability to misunderstand suppositions for facts, that all gingival pathologic processes are caused by spirochetes. If one talks loudly enough he will always find those who agree with him. But he cannot make the truth agree, for it does not change at his word. If one-tenth of gingival infections are caused primarily by spirochetes, and most of these by Vincent's organisms, it is of these I am speaking, so do not forget that we are not disregarding other etiologic factors, but have just placed them aside for the present.

I do not hesitate to say that I am fairly bubbling over with this subject. For three years, I have been holding back, trying in every way to convince myself that Vincent's infection is uncommon, that it is only an acute infection, and has nothing to do with the every day pathologic conditions of the oral cavity. I have had the brakes on because I realize how easy it is to become overenthused and see everything the way one hopes to see it. I also realize that the adolescent mind cannot see through the eyes of experience, and I have constantly kept in mind the fact that I may be missing some important facts that are familiar to you. But the evidence has been too great, the truth

*From the University of Oklahoma School of Medicine.

*Read before the Oklahoma State Dental Society, Tulsa, Okla., April 28, 1926.

too obvious, the brakes have been burned out and the wild ride is on. I may be drunk with enthusiasm, but if it is based upon truth, if it is a step toward a better understanding of mouth pathology and the reactions to oral infections, I am happy in my intemperance. False modesty must be dispensed with in order to deal with the subject at hand. I cannot agree with the many treatments offered—they all help but few are really successful—and I must ask your pardon for delving into so-called "theory" in order to bring out the facts.

This paper deals only with Vincent's infection of the oral cavity, and, while I hope that some of the things brought out at this time will prove of value in treating Vincent's angina, which is the throat condition caused by the same dual organism, it is most probable that conditions in that location require treatment of a different character from when the pathologic process is in the mouth.

Acute Vincent's infection has been beautifully described by Vaughn, Rattner, Mangel and many others. It is only with their treatment of the condition that I would differ. For example, I would disagree with Rattner if he still advocates several widely different treatments for this condition; for a majority of them must obviously be empiric because of their difference from one another. Of course, it is possible to get results from almost any treatment, but we want the best possible result, and that can only be consistently secured by rational treatment after a careful and accurate diagnosis. It is the purpose of this paper to offer you such a treatment and to prove that it is rational.

Now let us investigate the habits of the etiologic factor in this disease so that we may reason out a rational treatment, and not blindly switch from one drug to another until the condition becomes mildly chronic and both you and the patient think he is cured. One author "strongly recommends" fifteen different drugs for this condition.

Vincent's infection is a disease caused by *Bacillus fusiformis* and *Spirochaeta vincenti*. The bacillus is from 3 to 10 microns in length and from 0.3 to 0.8 micron in thickness, the greatest diameter being at the center. It is anaerobic when grown artificially, but probably is a facultative aerobe. It may be grown artificially only on carefully prepared mediums and under ideal conditions. Small colonies appear on Loeffler's blood-serum in four days. The growth decolorizes litmus milk. It grows quite well on acetic agar. A fetid odor is produced in all cases. The colonies die if left below 37 C. for a few hours. After about four days under ideal conditions, spirilla appear in the mediums. They are long and slender, nonmotile and flexible. The bacilli stain violet, and the spirilla pink, by the gram method. If the mediums have a p_H value of 4 when the culture is started, the spirilla appear when the medium has attained a p_H value of 7 or 8.

The conclusions on cultural investigation are:

1. The dual organisms of Vincent's infection are two forms of the same organism.

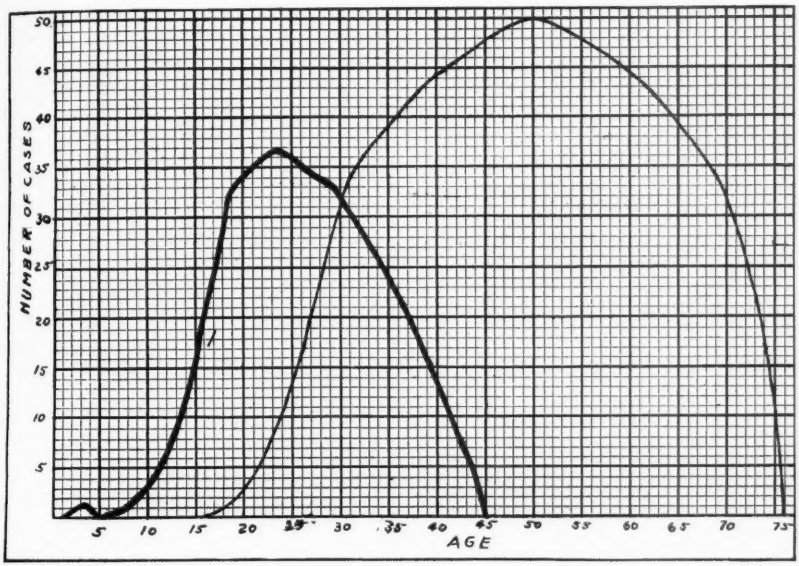
2. Vincent's organism is anaerobic, and lives best in a slightly acid medium.

3. The growth of the organism changes its environment in such a way that it is self-limiting, but usually not self-exterminating. (This is true of practically all animal parasites.)

4. The fusiform is the more resistant to unfavorable conditions. It will not grow under aerobic conditions, but will live for several days.

Severe acute Vincent's infection is characterized, in the mouth, by lesions covered by a grayish necrotic membrane which, when rubbed off, leaves a raw bleeding surface. It is very painful, the above mentioned signs being accompanied by fever, headache, malaise, nausea, marked salivation, cervical adenitis, gingival hemorrhage, constipation and a peculiar "sweetish-sour" odor of the breath. In a few cases, the toxemia was quite marked, the leukocytes passing 20,000, with from 7 to 10 per cent eosinophils. The coagulation time of these patients is usually from six to twelve minutes.

The following experimental data will aid in explaining the treatment adopted:



Graph of 362 cases of Vincent's infection according to age. The heavy line represents acute cases, and the light line the chronic cases.

1. All blood cultures from infected patients were negative.

2. Mediums containing blood from patients with chronic Vincent's infection did not grow the organisms.

3. All attempts to inoculate lower animals were unsuccessful.

It has long been recognized that there are a few drugs which are of

special value in treating diseases caused by spirochetes. They are certain forms of arsenic, mercury and bismuth, the first being used for nearly every disease of spirochetal origin. It seems to have more spirocheticidal power than any other drug provided it is put in direct contact with the organisms. Since we are dealing with a purely local disease as far as the etiologic factor is concerned, it is logical to apply the arsenic locally. Experience tells us that we can apply neo-arsphenamin or sulpharsphenamin to the mucous membranes daily with no reaction. When the physician gives arsphenamin intravenously for certain stages of syphilis he is doing a rational thing because the organisms are there. When arsphenamin is given in the same way for a purely local disease, that can be completely and successfully treated by local application, it is an irrational and empirically nonsensical procedure. This statement is made in spite of statements to the contrary by many writers, none of whom have published any evidence to prove their assertions. So we may conclude for the present that the use of neo-arsphenamin locally is a rational procedure.

Nature's reaction to insult is manifested by inflammation, by hypertrophy or resorption, and by pus formation. Inflammation is characterized by swelling, redness, heat, pain and loss of function. Those diseases that excite the most violent reaction are, as a rule, acute. They reach a climax and then subside, usually resulting in complete cure and immunity for life. Those diseases that do not excite inflammation do not reach a definite climax, but become chronic. They do not produce immunity, and in the end are very destructive.

Vincent's infection is a disease which does not cause pus formation. It does not cause the production of hormones, and the defensive weapon we so often depend on to protect us against infection, phagyocytosis, is not brought into use. When acute, the pain is intense—Nature cries for outside help because she seems almost powerless. The other signs of inflammation are not marked. The condition is more acute than some other diseases of spirochetal origin because it is marked at once with destruction, rather than proliferation of the attacked tissue. It does not seem to enter the blood stream, but progresses by destruction of the connective tissue. The endothelium remains intact, but it is easily broken down mechanically on account of loss of support and protection, causing intense bleeding. This bleeding is Nature's only defensive reaction. Having no other means, she attempts to wash the enemy away. The saliva becomes thick and mucinous, and there is an abundance of it. When the throat as well as the mouth is attacked, I have seen cases in which the mucus was so thick and copious that the patient was almost drowned, it being necessary to give atropin to control the secretion. Death has occurred in this way—possibly many times with the disease unrecognized, certainly a few times, to my direct knowledge.

Now let us give attention to the fusiform organism. It seems to be quite resistant to the arsenic treatment. However, we have found that it is an anaerobe. It is true that it will continue to exist for some time in the

presence of oxygen, but it will not multiply. It is logical, then, to use some oxygen-liberating compound to check the growth of these organisms. For this purpose, we have three very good drugs: potassium permanganate, sodium perborate and hydrogen peroxid. They all liberate oxygen. Potassium permanganate in 1.5000 dilution is good. It has a disagreeable taste, however, and to prescribe it to a patient as a mouth wash is vain unless he is very conscientious. Sodium perborate is a white powder soluble in cold water. When freshly dissolved, it gives off about 9 per cent available oxygen. It is very good, but will not keep in solution, and will lose strength in the solid form if kept in a warm place. Hydrogen peroxid is a solution capable of yielding ten volumes of free oxygen. It may be used as a mouth wash when diluted in an equal volume of water. It is tasteless and easily procured fresh. We have chosen it as our oxidizer, though any of the drugs mentioned will serve equally well if fresh and used faithfully. Having the disease under control with the arsenic and peroxid, we must use something to kill the fusiform bacillus. A large number of antiseptics may be used for this purpose. Copper sulphate is very effective, and, for uniformity, it has been used on all cases reported here.

It is only fair to admit that thirty-seven cases were treated by other methods before the foregoing conclusions were arrived at. Many other cases were discarded as being of no value because of carelessness of the patients in returning regularly for treatment.

The recent literature on this subject is interesting. Smeltzer has given us an excellent article.[1] He has had a broad experience, especially with the severe, epidemic type of infection. He suggests that the organism is much more virulent in some cases, being very infectious and causing violent reaction and destruction. I have seen only a few cases of this kind, but it is true that the disease becomes more severe at times. I have observed that it is much more common during the fall and winter. He mentions the fusiform bacillus as being the destructive organism, while I believe that the spirochete is more responsible. This article is the best one published during the last five years. Leach[2] recommends the quartz lamp as the treatment par excellence. He does not substantiate his statement with case reports. Hyde[3] tells almost everything that should not be done in treating this condition. Even his staining *Bacillus fusiformis* is wrong. He says it is gram negative, while it distinctly is not. The results he reports are in accord with his method of treatment. Many other articles have appeared recently. Fisher[4] reports a case of purpura hemorrhagica with Vincent's infection a possible etiologic factor. This case, with increased bleeding time, substantiates my experience many times over.

The following cases have been treated during the past three years. For

1. Smeltzer, J. L.: Diagnosis, Classification and Treatment of Vincent's Infection, J.N.D.A., 8: 924 (Nov.) 1921.
2. Leach: Dent. Items Int., October, 1925.
3. Hyde: Dent. Items Int., August, 1925.
4. Fisher: Dent. Cosmos, July, 1925.

your convenience, I have grouped similar cases.

Group 1.—This group contains forty-nine cases of severe acute Vincent's infection associated with no other disease undergoing treatment that might have had some effect on the Vincent's infection. The ages range from 5 to 45 years, with thirty male and nineteen female patients. The condition before treatment has already been described. These patients were all treated with neo-arsphenamin, full strength, locally once a day, and 5 per cent hydrogen peroxid as a mouth wash every two hours. The pain was relieved in from three to four days, and all evidence of tissue destruction disappeared. The smears at this time reveal few spirilla and many fusiform organisms. As soon as it was evident that the infection was checked, about the eighth day, ten per cent copper sulphate was used once daily after the neo-arsphenamin. All teeth were scaled and polished on about the twelfth day. After this time, four smears were taken daily, and the full treatment was continued until all tests were negative for three consecutive days. Then the patient was instructed to return at once in case a recurrence of any of the signs or symptoms should be detected. If extractions are necessary, they may be performed at this time. All of these cases were completed in three weeks. One patient returned in seven months with a patch on the tonsil, but no evidence of recurrence in the mouth.

Group 2.—This group contains forty-two cases of mild but acute Vincent's infection. The ages range from 14 to 34 years, with eighteen male and twenty-four female patients. These cases had none of the signs described for the severe infection except slight hemorrhage from the gingivae, accompanied by pain. The symptoms consisted of a continual bad taste in the mouth and some loss of appetite. The diagnosis can be completed only by smears from under the gingival margins and the interproximal spaces. Treatment was essentially the same as for Group 1 except that a greater effort was made to place the arsphenamin where the smears were positive. Ten per cent neo-arsphenamin in glycerin was applied between the teeth and along the gingivae. When scaling, the instruments were dipped in this solution. All smears were negative in from four to six days, but the treatment was continued for from one week to ten days. Hydrogen peroxid and copper sulphate were used as in Group 1, and the patients instructed to return if necessary. None returned in this group.

The next two groups are of chronic cases. They were all compiled during the last fourteen months, chiefly because I failed to diagnose many of them prior to that time. The diagnosis of the cases was based upon two facts: (1) positive smears; (2) marked improvement after one treatment with neo-arsphenamin locally.

Group 3.—Mild chronic Vincent's infection. The signs of this condition are practically identical with those of mild chronic suppurative periodontoclasia. The gums bleed easily when brushed, there being some chronic passive congestion. When closely questioned, these patients will usually give a history of Vincent's infection having

been present a year or more ago, some having received treatment for it. Others will tell of having had Vincent's angina at some previous time. It may be of value to know that these cases do not respond well to the usual treatment for periodontoclasia, and the patient's bleeding time is increased. In a few cases, this condition was diagnosed after severe hemorrhage following extractions. The smears contain more fusiform than spiral organisms. This group contains sixty-four cases. The coagulation time ranged from two to seven minutes. A mouth wash containing Fowler's solution (solution of potassium arsenate) and hydrogen peroxid, used three times a day, caused marked improvement. Neo-arsphenamin was used a few times locally and the teeth were carefully scaled. After scaling, 10 per cent copper sulphate was applied. All smears were negative, and no coagulation time was over three and one-half minutes after four days' treatment. These cases were treated for an average of ten days before being discharged. The ages ranged from 25 to 52 years.

Group 4.—These cases resemble periodontoclasia. They may become even more severe than acute cases at times, though this is unusual. Some have all the signs and symptoms of the severe acute infection, while others can only be differentiated from periodontoclasia by smears and the response to treatment for Vincent's infection. The danger in failure to diagnose these cases are: infection after extraction and hemorrhage. This group contains seventy-four cases. Treatment was the same as for the severe acute group. Some of these patients experience little or no pain, and it is difficult to make them understand that the mouth condition must be cleared up before any teeth can be removed. The age of these patients ranged from 28 to 50 years. All tests were negative in about two weeks, but the cases were treated longer because many extractions were indicated.

Group 5.—This group contains eighteen cases having had treatment for syphilis (neo-arsphenamin intravenously and mercury intramuscularly) for at least two weeks previous to the first appearance of Vincent's infection. All of these were severe acute or severe chronic cases. The treatment described for Group 1 was successful in all these cases. From this, we must conclude that it is not good practice to give neo-arsphenamin intravenously for oral Vincent's infection. Two patients were receiving intensive treatment with neo-arsphenamin and mercuric cyanid for four months before Vincent's infection was diagnosed, and both cases were severe. They cleared up under the usual treatment as described here, no change being made in the antisyphilitic treatment. Again I wish to state that if intravenous medication with neo-arsphenamin will not act as a prophylactic, we cannot expect it to be an appreciable aid in curing Vincent's infection, and it is not rational for us to expect it to be.

Group 6.—Here I will describe four unusual cases:

REPORT OF CASES

CASE 1.—A white girl, aged 10 years, with a temperature of 101.4, pulse, 90, respiration, 40, had dry lips, with small ulcerations at the corners; whitish patches on the tongue, roof

of the mouth and tonsils, and tongue, lips and cheeks so swollen so she could open the mouth only with difficulty. The gingivae were congested, with loss of interproximal tissue by necrosis. The case had been diagnosed as Vincent's infection and Vincent's angina one week previously, and treated with alkaline mouth washes. At my suggestion a mouth wash containing potassium arsenate and hydrogenperoxid was used. The patient was almost well when I saw her, four days later. This was not my case, so I did not include it in the regular groups. Here was a case with very high resistance, the reaction to the infection being intense. All that was necessary was a little aid, and the case began to clear up immediately.

CASE 2.—A white girl, aged 18 years, presented a severe acute case, which was allowed to go on for a week with no treatment except two injections of neo-arsphenamin. The Wasserman reaction was 4 plus; coagulation time, twelve minutes. When she was first seen, the temperature was 101.6, respiration, 38, pulse, 100. She was bleeding quite freely from the gingival margins, possibly a quart of blood a day. The odor from her mouth was very foul. She was crying with pain, though she had had one-sixth grain of morphin one hour previously. The jaws were swollen, and the lips dry. All smears were positive. Neo-arsphenamin was applied at once, and a mouth wash every two hours ordered. Owing to an error on my part, the mouth wash was not given, but when I went to see the patient the next day she was sleeping. No more opiates had been given, and the hemorrhage had almost ceased. In three days, the mouth was clean, there being no odor, hemorrhage or necrotic tissue present. From the second day of treatment, the temperature never passed 99, though for a week previous it, had risen above 101 daily. I had used such a large quantity of full strength neo-arsphenamin, the patient getting it intravenously at the same time, that I did not treat her on the fourth day. On the fifth day, the gingival hemorrhage had started again, so I decided not to rest the treatment again. I was absent three days, and her physician did not continue the treatment as I had ordered, "because the mouth looked well." When I returned, I had to start the treatment all over again. Under the regular treatment the case was cured in three weeks. The first two weeks that the patient was in the hospital, she was unable to walk because of loss of strength. The third week, she came to the dispensary for treatment.

CASE 3.—This was of chronic type, somewhat different from those already described. The patient came to me two weeks after she was supposed to have been cured of a slight Vincent's infection of the tonsils. Her history was as follows: Three weeks previously, she had been treated by a physician for a slight infection of the tonsils diagnosed as Vincent's angina. Arsphenamin, 2 per cent, in glycerin was used locally, and the condition cleared up promptly. About a week later, the patient noticed that the lower left third molar felt uncomfortable, and she went to a dentist to have it removed. The tooth broke off. After an incision to remove the roots, the hemorrhage was so great that the operator was forced to abandon the operation. The hemorrhage was stopped wth considerable difficulty. The coagulation time was taken and found to be over six minutes. After the administration of calcium lactate had reduced the coagulation time to two minutes, another attempt was made to remove the roots. The hemorrhage this time was just as bad as before, and nothing could be done. After two weeks' treatment, the roots were easily removed. In another similar case, I treated the patient until the infection was cleared up, but she was afraid to have the roots removed on account of her unfortunate experience.

When these patients came to me, there was some necrosis in the socket from which the crown had been removed. Smears revealed the presence of many fusiform organisms. Only a few isolated spirals were present, and these in only one of five smears.

The microscope is indispensable in the diagnosis of oral lesions. We must know what we are fighting if we are to choose our weapons rationally. The treatment outlined is based upon microscopic diagnosis and observation. For example, when the smears show only a

few spirilla, we begin to use copper sulphate. When all smears are negative for three days, we discharge the patient, and not until then. Several smears should be made each time. They should be stained and examined by one who is familiar with oral bacteriology. Some technicians are very competent, while others have no idea what to look for.

CASE 4.—A man, aged 27, had "trench mouth" when in the army. Since he had been "cured," the gums had been very sensitive, bleeding easily. Examination revealed that the gums were firm, except for hypertrophy of gingival margins. Along the lower molars, the gum margins were loose, there being no interproximal tissue. The gum tissue could be lifted from the teeth for a depth of from one-fourth to one-half inch. There was no active inflammation and no pus formation. Smears were doubtfully positive for Vincent's infection. Under the regular treatment for Vincent's infection, the hypertrophy disappeared and the gum tissue became firmly attached in three weeks. This case is typical of many others.

In order to facilitate the use of hydrogen peroxid as a mouth wash, and at the same time provide for the use of arsenic several times daily, I have been using the following prescription recently:

Fowler's solution ..... Drams i
Glycerin ..... Ounces i
Wine of ipecac ..... Drams i
Hydrogen peroxid ..... q. s. ad Ounces iii
M.
Sig: Use as mouth wash four times a day.

The glycerin keeps the potassium arsenate in solution, while the wine of ipecac imparts a pleasant flavor. This is an old prescription, and is not original. The neo-arsphenamin is used full strength in nearly all cases. At times, a 10 per cent solution in glycerin is easier to apply. For this work, sulpharsphenamin is equally effective. I find no advantage in the sulpharsphenamin supposed to be manufactured especially for local application. It should be sold at a lower price as it does not need to be so accurately standardized as that sold for intravenous use.

Other factors observed that have not been brought out may be summarized as follows:

1. In only three instances did we find more than one of the family infected. We were able to examine twenty-seven families of infected patients.

2. One case was found among the negroes. This seems unusual since they are very susceptible to other spirilla.

3. The majority of cases are found in young adults, though there seems to be no age limit.

4. The 260 cases here reported were selected from 362 cases, 102 cases having incomplete treatment or treated by other methods for the purpose of determining their value.

There is room for much research work on this disease. We should follow up the experimental fact that the organisms do not grow well on culture mediums containing blood from infected patients. Bismuth and ultraviolet radiation present possibilities for better treatment. The mode of transmission has not been traced out. If this is done, it will become possible to eradicate the disease completely. With this end in view, the state health department should require all dentists and physicians to report every case. Experi-

mental inoculation of animals, if successful, would uncover some new working knowledge. I believe it can be done by good workers.

CONCLUSIONS

Vincent's infection is a mildly communicable disease, serious but seldom fatal. It becomes very infectious at times.

The intravenous use of arsphenamin has little or no effect on this disease in the mouth.

A mild toxemia, with some change in the blood that prolongs the coagulation time, possible by lowering the blood calcium, is present in even mild cases.

Vincent's infection may become very mild, and chronic, after incomplete treatment, rendering the patient immune to its noticeable harmful effects, but making him a carrier of the disease. In every case of Vincent's infection of the mouth or throat, the mouth should be thoroughly treated for at least two weeks by a dentist well versed in oral prophylaxis. The practice of manufacturers recommending their product as being "good for" Vincent's infection just because it is a mild antiseptic is ridiculous.

I must mention the problem of superimposition of oral disease. There are few mouths that have only one pathologic entity in them, and we must establish the diagnosis of each condition separately, determining the etiologic factor as well as possible in each case. The treatment that I have suggested to you is for Vincent's infection only, and it must be supplemented by other treatment when indicated.

Most of all, I wish to warn you that this treatment is based upon microscopic diagnosis and supervision. If you do not diagnose and follow your cases with the microscope, and the treatment here advocated fails to produce the desired results the treatment should not be condemned.

1205 Medical Arts Building.

INTERPRETATION AND REGISTRATION OF MANDIBULOMAXILLARY RELATIONS AND THEIR REPRODUCTION IN AN INSTRUMENT*

By RUSSELL W. TENCH, D.D.S., New York City

UNFORTUNATELY, the problem of mandibular movements and their utilization in full denture prosthesis has been so involved in geometrical hypothesis that it has become totally unintelligible not only to many who have undertaken to understand it but also to their followers. In fact, mysticism has so largely taken hold of thought in this field that we have at this time several cults, the disciples of which are so loyal to their idols or ideals, call them which you will, that they seem willing to fight to the death in defense of their faith. Many of these disciples seem unwilling to believe that the faith of others has any saving grace in it. Their prophets have given us images to worship, enshrouded in mystery, to be taken on faith. Behold the floating condyle theory, the conical theory of the movements of the mandible, the spherical theory of the movements of the mandible; to say nothing of the old faith still adhered to by a vast majority of our otherwise progressive profession; to wit, the open and shut or plane articulator cult.

Around these cults have been built technics—this man's technic or that man's technic—all having enough of good plain truth in them concerning denture technic in general to be somewhat satisfactory to the uninitiated, but most of them partially disclosing the truth concerning the value of mandibulomaxillary relations. Most of these technics have been chiefly of benefit to the ego of the individuals who sponsored them. Certainly some of them have done more harm to scientific disclosures of the truth we are after than they have done good; for, while claiming perfection, they have only partly disclosed the truth and thus misled, confused and discouraged those searching for truth, who feel that they must forego expensive personal investigation and take on faith the teachings of others rather than let their God-given intelligence guide them.

I decry this condition and wait for the day when you and I will think enough to solve our problems each for himself. And I hope that we may take for proof not the slogan, "Can I get by with this?" but rather the slogan, "Is it right?"

The minds of most men are so made that it is extremely difficult to make progress in the scientific study of a simple problem like that which we have under consideration. Science is

*Read before the Section on Full Denture Prosthesis at the Sixty-Seventh Annual Session of the American Dental Association, Louisville, Ky., Sept. 23, 1925.

based, first, upon the banishment of all prejudice, upon a determination to get all the facts, from any source, that bear on the subject; to weigh, to balance and to eliminate, until the truth is finally disclosed. Science examines a subject from all angles, investigating not only what seems to be truth, but also that which seems to be untruth, until, piecing all together, some supposed facts must be excluded as bad and others retained as good. Albert C. Ingalls says of scientists, in a discussion of the origin of man, "Real scientists love peace and hate controversy. They remain mostly inarticulate, believing that in time truth will prevail."

The trust and confidence placed in us by our patients places us on our honor and lifts the dealings we have with them out of the commercial transaction class into that of service. This trust should make it abhorrent to any of us to seek to evade our plain responsibility by refusing to acquaint ourselves thoroughly with the facts necessary to a professional solution of the complex and difficult problem of constructing artificial dentures.

The widespread total disregard of the simplest fundamentals of denture prosthesis is a disgrace to the dental profession. It exists in high places as well as low, and while we may occasionally excuse the failure to render the highest type of service in the less wealthy communities, such as dot the map of industrial and poor agricultural sections of the world, no excuse can be offered for those who are collecting good fees for deplorably inferior service. I honor the criminal who takes a chance to pick my pocket more than I honor these gentlemen who continue to sell artificial dentures without taking the trouble to learn how to make them.

The various relations of the mandible to the maxilla during masticating movements are of the utmost importance in all dental operations. A clear understanding of these relations is therefore of importance, not alone to denture prosthetists, but also to every practitioner attempting restorations or changes of any nature in the position of teeth, if such operations involve or affect the position of the occlusal portions of the teeth of either arch.

The operator effecting restorations that involve the replacement of one or more missing teeth when the remaining teeth are intact, and in good occlusion and articulation, has in such remaining teeth a guide and plan for the restoration he is to make. A full denture prosthetist, on the other hand, when commencing the design of a full artificial denture has no such visible guide or pattern to follow.

The problem that we have under consideration concerns those relations of the mandible to the maxilla that affect the design of artificial dentures; what these relations are, how they may be detected and what kind of instrument will conveniently reproduce mandibulomaxillary relations so that they may be used in planning the design of artificial dentures.

The answers to these questions have been sought by many students of the subject. Each, in selecting his answer, has had the choice of many alternatives, dependent on the clearness and completeness with which he has been able to see beyond the shroud of mystery that seems to hide the simple truth concerning this phase of denture prosthesis.

The establishment of an objective to be attained is the first essential in any endeavor. The architect draws his

plan: the tourist maps his route: the dentist plans his technic.

The objective of full denture prosthesis is the building of an artificial substitute for the missing masticating members and also, as conditions permit, the restoration of expression and speech, changed by the loss of alveolar and dental tissue.

To design intelligently a full artificial denture, it is necessary to be familiar with the manner in which the mandible functions in mastication and speech. Dentures built without knowledge of these functions, or any consideration of the manner in which these functions may be facilitated for the edentulous, by denture design, are certain to be unsatisfactory from almost every point of view, except perhaps as a means of separating a trusting patient from his money.

Let us consider what happens to the mandible when it is employed by the patient for mastication or in exercising the function of speech; starting from the position of rest.

The actions of the mandible are, for the most part, automatic and occur without the slightest conscious direction. It is due to this semiautomatic control of the mandible that its precise action is so obscure to the less analytically minded of us; notwithstanding the fact that we have in ourselves a completely equipped laboratory for investigation of the phenomena associated with mandibular movements.

When the mandible is at rest, the muscles of mastication are relaxed. The lips are usually in contact, and a slight vaccum is created in the oral cavity which permits the weight of the pendant mandible and associated muscles to be supported by atmospheric pressure. The mandibular teeth are separated from their maxillary antagonists by from 2 to 4 mm. In this position, the face is said to be in repose. The tongue is expanded by the partial vacuum just mentioned and the curved anterior superior surface of it is pressed against the hard palate. Its sides and tip are in contact with the molars and bicuspids and the incisor teeth, respectively. The marginal borders of the tongue project laterally somewhat into the free space existing between the dental members of the two arches. When the mandible is drawn by its activating muscles toward the maxilla, the tongue contracts and the opposing teeth come into contact. When the natural denture is intact, this position is automatically assumed, in the act of swallowing, of which it is the initial movement.

In edentulous patients, when the mandible moves closer to the maxilla than normally, it can be noticed that the cheeks are pushed outward at the angles of the mouth, and the lips project, owing to the compression on themselves of the muscular and nonmuscular tissues of this region.

When the tissues missing in an edentulous mouth are replaced by well designed occlusion registration bases, commonly called biteplates, the relations of the tongue, cheeks and lips to them should be the same as I have outlined for the rest and closing positions of the mandible. Opening or increasing the distance between the edentulous ridges more than enough to permit such a condition to exist gives the muscles a strained position, which interferes with the habitual functioning of tongue and buccolabial muscles.

Extreme opening of the bite, advocated by some, usually subjects the pa-

tient to a long period of discomfort before he becomes adjusted to this unnatural condition. He is handicapped both in masticating and in enunciating clearly. The effort required of the patient in accommodating himself to this unnatural condition is usually much greater than the results obtained would seem to warrant.

Extreme opening of the bite has also the effect of inclining the surface of the mandibular ridge so that pressure

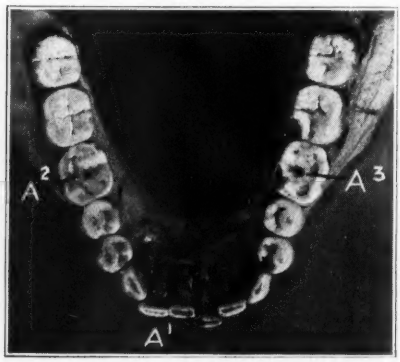


Fig. 1.—*A1*, *A2* and *A3*, points utilized in tracing movements in mastication.

in mastication may cause a forward displacement of the mandibular denture. This is a common cause of irritation of the mucosa on the lingual bicuspid aspect of the mandibular ridge.

In speech, the mandible may only ascend and descend to allow the tongue to act against the teeth in forming syllables. In other instances, it also advances to permit the cutting edges of the mandibular incisors to assume a position directly below the cutting edges of the maxillary incisors. This phenomenon is observed in patients who have developed great overjet and overbite in the incisor region. Hence, many patients exhibit two horizontal positions for action of the mandible; a posterior one for mastication, and an anterior one for speech, while others use the mandible in practically the same anterior posterior position for incising, for crushing food or for forming syllables.

As the mode of action of the mandible in speech does not affect the adjustment or design of an instrument for imitating mandibular masticating movements, it will not be further considered at this time, although it is of vital importance in the planning of denture design.

In studying the behavior of the mandible, when functioning in mastication, we know that it is activated by groups of muscles, arranged in pairs, on the right and left sides of the skull respectively. The actions of these muscles, fortunately, need not be understood in detail. It is sufficient for the purpose of our investigation to know that they act to thrust the mandible forward from the rest relaxed position and to return it to this position of rest; that the mandible may be drawn upward toward the maxilla and that it may be retracted away from the maxilla downward and backward in closing and opening the mouth. The muscles activating the mandible also will move it to the right or to the left. Combinations of two, or all three of these simple motions, with any one predominating, are used in all actions of the mandible in speech or in mastication. (Fig. 1.)

Taking similar fixed points on the right and the left molar regions of the mandible and a fixed point in the median incisor region, preferably on the occlusal and incisal surfaces (Fig. 1, *A1*, *A2*, *A3*), let us trace the movements of these points in mastication. Assum-

ing the patient to be masticating on the left side, the fixed point on the right or balancing side would move downward, forward and toward the saggital plane until the bolus of food was placed between the molars of the left side by the tongue. With the bolus in position, the crushing of it will produce an upward motion of the fixed point on the right side, followed, when the teeth come into contact, by an upward outward backward movement, until the point reaches its position of starting. Watching the point established on the left or masticating side, it would be seen to travel downward, outward and slightly forward until the bolus is placed; then upward, and when the teeth make contact, upward, backward and inward to its starting point.

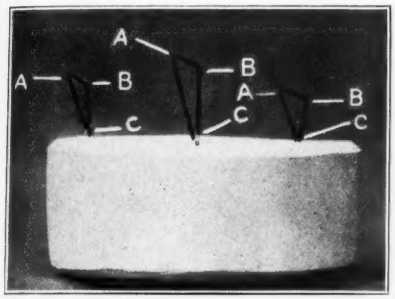


Fig. 2.—Front view of model, showing relative opening and lateral movement of points *A1*, *A2* and *A3* (Fig. 1). *A* to *C*, opening movement starting from central occlusion; *C* to *B*, closing movement; *B* to *A*, working or masticating movement returning to central occlusion.

The movement of the point in the incisor region would follow a course similar to that of the left side, but its movements will be somewhat greater in magnitude. (Figs. 2 and 3.)

In the incising function, the points under observation will be seen to travel downward and forward, then upward, and when the incisors make contact, upward and backward, to the starting point. The amount of forward movement will depend on the habit acquired by the individual in accommodating his muscle action to the overjet and inclination of the maxillary incisors. Also the magnitude of movement in a lateral direction during mastication will depend on the arrangement and dimensions of the molars and bicuspids.

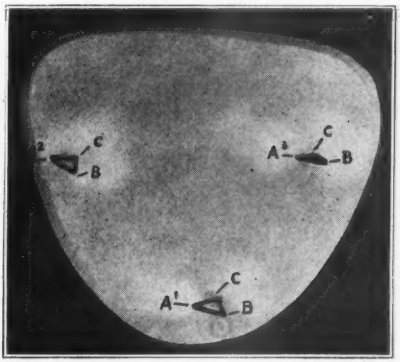


Fig. 3.—Top view of model shown in Figure 2. The cusps on the right or balancing side (facing reader's left in Figures 2 and 3) have more forward movement in masticating than those on the working side, or left of patient, in these illustrations.

Usually, one molar point will travel forward with a slightly greater acceleration than the other in the incising act. Most often, the left side will exhibit this characteristic.

The patterns made by the movement of the three fixed points when mastication is proceeding on the right side will be, in the main, the reverse of those made for the left, but may not correspond in magnitude, degree of inclina-

tion or direction of movement with the left masticating records. In some cases, they will agree almost exactly on right and left, and in others they may differ much.

These patterns are often found to vary greatly in different individuals.

If they are to be reproduced in an articulator, it is evident that their reproduction will require an instrument with a greater range of movement control.

Carefully made records of one individual at different sittings within a short period of time will correspond closely for the right and left sides, respectively.

Habit is defined as a word used to denote a mode of physical action, generally acquired, so established by use as to be involuntarily or unconscious; a fixed disposition to do a thing, and a facility in doing it, the result of numerous repetitions of an action.

The habit of mastication is recorded in the automatic centers of the brain in the same manner and with the same persistence that the habit of signature writing or any other unconsciously controlled movement is recorded.

That the movements described vary in different patients in small or large degree is due to variation of conditions that are fixed for each individual, which effect the acquisition of an habitual, unconscious manner of performing the masticating act easily, in accordance with the restrictions these fixed conditions impose.

These individual fixed conditions are (1) the relation of the mandible to the maxilla in position, form and size; (2) varying relations of form, size and direction of action of the muscles activating the mandible, and (3) variations in size, in cusp form and in position of the teeth in the arches of individual patients.

Variations in dimensions and shape of the bony framework and musculature of our bodies gives us our individual bodily or facial appearance. So great are such individual variations that it is rare indeed to find two individuals that compare in all details or, as we say, resemble one another. One individual walks with a long stride, another with a short; one toes in, another out; one man writes his signature one way, another in a different hand, even though trained to use the same system of penmanship at school.

Why, when we have evidence all around us that individuals vary in particular details, is it apparently so difficult for some designers and users of articulators to realize that the masticating apparatus must be subject to the law of individual variation and that the movements of the masticating apparatus of an individual must, in compliance with this law, vary on the right and left sides of the same individual in many instances.

The methods of determining individual variations in mandibulomaxillary relations adopted by Gysi are accurate, in capable hands. He has demonstrated marked differences of mandibular movements on the right and left in individuals and between different individuals. Similar or related methods in the hands of workers as careful as Professor Gysi lead to the conclusions that he has reached. (Fig. 4.)

When the teeth are lost, an important guide to the determination of the masticating movements of an individual is also lost. However, it is possible in all cases, by proper procedure, to reconstruct to an accurate degree a picture of the individual masticating move-

ments, thanks to the persistence of habit.

It is not in the least necessary to become involved in a study of the geometry of mandibular movements, to get satisfactory records which may be used to check the adaptability of an articulator, or for studying the manner in which the mandibular arch or teeth behave in their relation to the maxillary arch or teeth in mastication. It is also obvious that it is not necessary for the prosthetist when recording mandibular movements to be much concerned about the movements of the mandible in function, when the teeth are separated. This, then, brings us to the reutilization of an old idea lately found useful.

Christensen, years ago, registered in wax the change in the relation of the mandibular ridge to the maxillary ridge when it is protruded from the central occlusion position. He used this registration to adjust an articulator. Waugh, of New York, in 1908, took lateral bites in wax to register the movements of the mandible. That these methods did not gain popularity was not due to wrong reasoning but to inaccuracies of technic and the lack of an instrument that would adjust fully to the records.

The registration of condyle movements by lateral and protrusive bites involves observance of the following:

1. Accurately fitting occlusion registration, or bite plates.

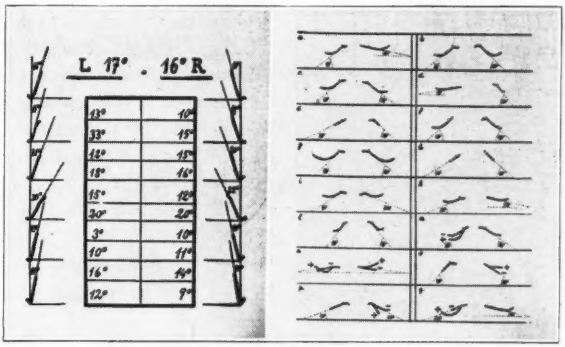


Fig. 4.—Variations of movement in the right and left condyle regions of the same patient and also variations in movements of different patients. (From Gysi.) Records made for the same patients as in Figures 2 and 3, at points *A1*, *A2* and *A3*, Figure 1 would show similar variations. The magnitude and inclination of the movements would be slightly different when recorded in the molar and incisor regions instead of the condyle region.

2. The registration, definitely and visibly, of the central occlusion position of the mandible, as a starting point. (Gysi gothic arch.)

3. Assuming the movement in mastication of the facets of one dentition against another to be on a straight line. It is only necessary to locate two points in this straight line to know the path the line takes through space.

4. Knowledge that the grinding action of the molars does not involve a bodily forward movement of the man-

dible on the side of the mouth in which the mastication is taking place.

5. Recognition of the fact that the mandible is depressed vertically as well as protruded at the beginning of the incising action.

6. Use of an instrument for reproducing mandibular movements from lateral bite records that is built with sufficient accuracy and that may be worked easily enough to allow of its being adjusted to individual mandibular movements by interocclusal bite registrations.

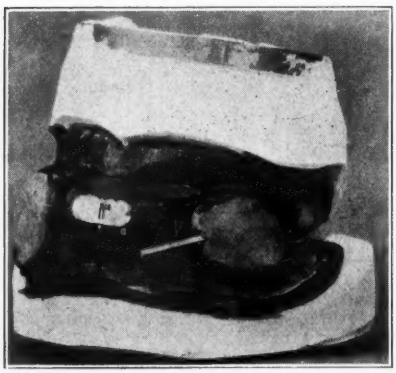


Fig. 5.—Occlusion plates with incisor path marker and registration tongue of brass in place. The compound bite locks sealed to the occlusion plates are also shown. The occlusion plates shown in this illustration are for a practical case and are made of modeling compound reinforced with aluminum trays.

Note: Since writing this paper, the author has found it advantageous to inset the metal tongue, on which the gothic arch is traced, in the compound occlusion rim so that the surface of the plate is 1 mm. or more below the plane of the rim. The occlusal surface of the bicuspid molar regions of the mandibular occlusion rim is reduced to the width of from 1 to 2 mm. by making concave cuts in the lingual and labial surfaces of the rim.

As time does not permit further amplification of technic, let us assume that registration plates or bite plates accurately fitting the edentulous ridges are ready; that the rim of the mandibular plate is built, with the middle of the ridge directly above the middle of the mandibular ridge, and that this rim approximately represents in width the buccolingual or labiolingual diameter of teeth suitable for the case. The maxillary plate rim meets the mandibular plate rim squarely or projects a millimeter or so bucally and labially beyond the buccal surface of the mandibular registration plate. The vertical dimension of the two rims should be sufficient to satisfy esthetic requirements and permit an efficient working length of the muscles of mastication. Any occlusal plane or curve within reason may be used, according to the fancy of the operator, or as required by the mechanics of ridge shape. (Fig. 5.)

TECHNIC

The technic for recording the Gysi gothic arch is as follows:

1. Attach arrow point tracing tongue to mandibular registration plate.

2. Attach incisor path registering device to median line of maxillary registration plate inclining the tracing pin downward and backward at about 16 degrees less than vertical.

3. Coat surface of arrow point tracing tongue with black wax.

4. Register arrow point tracings as follows:

a. Talcum occlusal surface of bite rims. (Gysi.)

b. Instruct patient to use only sufficient closing pressure to keep rims in contact, then trace forward backward movement.

c. Register right lateral movement, starting with the mandible in such a position that the tracing pin is in the anterior end of the forward backward tracing.

d. Register left lateral movement. (Fig. 6.)

4. Warm the occlusal surface of the maxillary occlusion rim slightly and instruct

the patient to close when the tracing pin is in position, to seat in the apex of the arrow tracing. Advise that pressure of closing must be equal on right and left, also that pressure must be made in the first molar region. Indicate this location to patient. If the mandibular ridge is steeply upturned at its posterior ends, the maxillary occlusion rim should be shortened so that closing pressure will not be transferred directly on this inclined surface.

The purpose in requiring a final equalization of pressure on the occlusion rims at this time is to eliminate an error often caused by the patient using a relation of the mandible to the maxilla other than the central occlusion relation when the original adjustment of the occlusion rims is made under closing pressure of the mandible; a heretofore unrecognized, but prolific source of trouble even when the arrow point tracing has been used.

The correct central occlusion relation is attained when the tracing pin is in the extreme anterior point of the arrow point tracing.

I have used this method of recording central occlusion for twelve years. During this time, I have observed its use in the hands of others, clinically and in private practice. In all that time, I have observed only three instances in which the gothic arch tracing did not produce the result desired, comfortable central occlusion. Two of these three cases gave histories which, with the old dentures being worn, led me to believe that the patient had acquired a post-extraction habit for using a protruded movement. The third patient insisted that she was most comfortable when a lateral bite error was incorporated in the central occlusion relation of her dentures.

I know of one case in which, with a natural dentition almost intact, mastication is accomplished at a protruded position of the mandible. There must be other similar cases though they are rare. Their existence merely bears out the theory that habit plays a part in determining the masticating movements of a patient. Such cases when encountered in an edentulous state might escape recognition till dentures had been in use some time. Reliance on the arrow point tracing is none the less valuable

Fig. 6.—Occlusal aspect of three mandibular occlusal plates for actual cases, with the incisor path tracings. Central occlusion is obtained when the mandible is in such position that the tracing pin attached to the maxillary plate is located at the apex of the angle. Variations in size and angle of the tracings may be noted.

because of an infinitesimal number of cases in which it does not seem to work.

During the period from January 1, 1923, to December, 1924, in all except the most important cases constructed I conscientiously attempted to get correct central occlusion without the arrow point tracing, to prove, if possible, that this technic was not necessary.

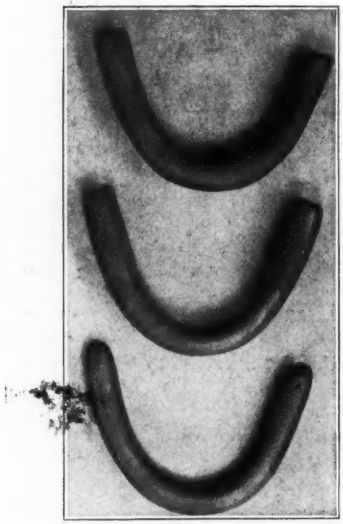


Fig. 7.—Rolls of soft compound ready for making the lateral and protrusive registrations.

Of about sixty cases constructed under this plan without the arrow point, many required heroic grinding in order to establish correctly a centric occlusion relation for the finished dentures, and at least twelve required the complete rebuilding of one or both dentures.

This, I admit, is a big price to have to pay to be sure of my ground, but I can now make the unequivocal statement that the Gysi arrow point technic is the only means that should be used in any practice to establish the most important single measurement taken in the construction of full dentures: the central occlusion relation of the mandible to the maxilla.

I am pained to make the statement, but it is wholly true, that those who aspire to teach full denture technic without familiarizing themselves with this method will fail in so doing to fulfil a plain duty to their students and followers. All of the methods so far advocated for getting correct central occlusion are mere deceptions and playthings, that delude those credulous enough to believe them into hours of wasted time, and cause their patients an ocean of discomfort. A failure correctly to record central occlusion, in one case in five, can pass the inspection only of those who do not wish to see or those too incompetent to see.

The making of records for the registration of the masticating movements of the mandible in an articulator is a relatively simple operation. It requires the interposing, successively, between the occlusion rims, of two or three small rolls of compound when the patient holds the mandible in the closed right lateral, closed left lateral and, if desired, in the incising position.

Compound is used for these registration guides rather than wax, because it sets to solid rigid form, which does not change. Its range and time of setting is greater than that of wax, and it is susceptible of more definite manipulation to control its hardness. (Fig. 7.)

The precautions to be observed in the technic are: (1) to see that the patient registers a true lateral position imprint without any protrusion component being introduced; (the Gysi arrow point tracing is ideal for guidance in this operation); (2) to secure these records

without exertion of enough force to unseat the registration plates.

The method of securing the lateral bite registration consists in introducing a small roll of compound between the occlusion rims, then requiring the patient to shift the mandible to the right or left lateral position and when the tracing pin, by its relation above the gothic arch, indicates a true lateral occlusion position, of about 5 mm., the patient is directed to close straight upward. The compound at this time should be only slightly resistant to pressure. The patient is directed to exert a small amount of pressure on the masticating side only; and to make no pressure on the balancing side. Both right and left lateral registrations are taken in the same manner.

Fig. 8.—Lateral and protrusive occlusion registrations. Above: right lateral; center: protrusive; below: left lateral registration.

The protrusive relation of the mandible is recorded by requiring the patient to close upon a small roll of compound when the protrusive position of about 5 mm. is reached. It is advisable to register this relation with the anterior edges of the occlusion rims separated about 2.5 mm. or the equivalent of an average depth of overbite. (Fig. 8.)

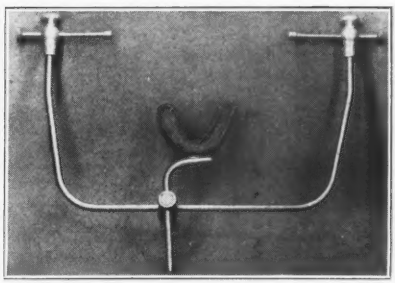


Fig. 9.—Hanau model of Snow facebow as removed from patient. Only the imprint on the upper surface of the mouth piece is used in mounting. This simple technic may also be used for placing partial denture casts or full dentures in the articulator correctly.

Following the registration of the protrusive and lateral occlusion contact positions, a facebow record is taken. This is accomplished by covering the prongs of a Hanau facebow mouthpiece, both top and bottom, with a mass of compound a little less than 10 mm. in diameter. When this has become set, the mass is introduced into the patient's mouth, between the occlusion rims. In this position, the patient is caused to close upon it so that a clean imprint of the occlusal surface of the maxillary

rim is produced in the surface of the roll. When the compound has hardened, the facebow is slipped onto the stem and the adapters are introduced into the external auditory meatus of the patient, locked at equal positions right and left, then lifted upward and forward into gentle contact with the top and front of the auditory canals. In this position, the facebow lock nut is set tight. The facebow is now removed. (Fig. 9.)

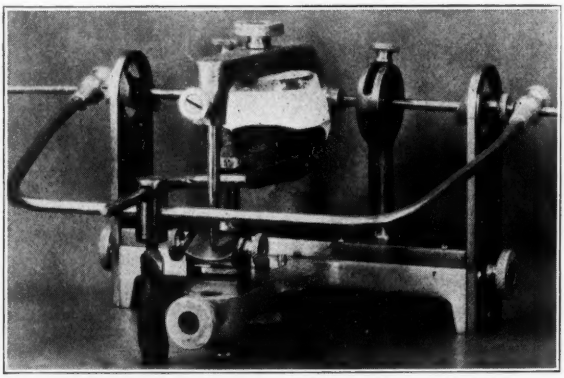


Fig. 10.—Manner of using the facebow to position casts in the articulator. This photograph was made just after the maxillary cast was attached to the maxillary arm of the articulator.

Right and left bite lock impressions are taken in compound. The occlusion rims are to be in central occlusion position at this time.

The choice of an articulator in which to register the relation just recorded is of utmost importance. The lateral bite registration method, in the past, has been impractical, for two reasons. Either the articulators adjustable enough to register the positions of the mandible in its various relations correctly were made stiff moving through spring pressure control, and, hence, worked too stiffly to permit using this method; or the relations could not be permanently recorded on the mechanism of the articulator so as to assure the operator that he was reproducing the patient's mandibular movements accurately when arranging the artificial teeth.

For two years or almost that length of time, we have had, in the Hanau kinescope, an almost perfect instrument for the use of this technic. It is the only instrument available to the profession at this time in which the mandibular movements can be fully recorded by interocclusal impressions. I lay stress on *recorded;* for, while there is an instrument available which will adjust to lateral bite registrations almost as well as the kinescope, it is totally lacking in any means of adjustment to permit its being set or adjusted to produce lateral bites in the instrument of the same value as those taken in the mouth. Unless an instrument can be so adjusted, its movements are of no practical value whatever to the full denture

prosthetist. When an instrument is adjusted, it should produce only the movements of the patient for which it is being used, and no other movements.

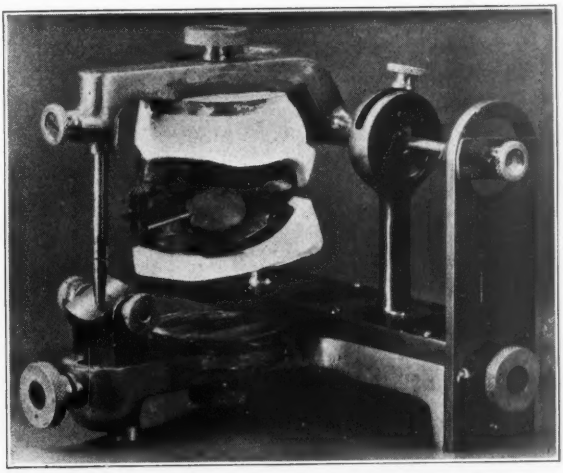


Fig. 11.—Casts on articulator, held in place to the occlusion plates with sticky wax. This assembly is ready for the addition of plaster to attach the mandibular cast to the base of the articulator.

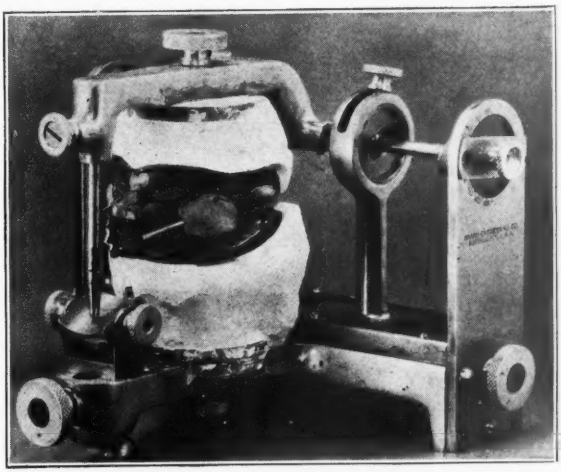


Fig. 12.—Mandibular cast attached to articulator, ready for removal of the lock impressions and recording of the patient's mandibular movements in the articulator.

In setting the casts of the edentulous mouth into the articulator, the usual procedure is followed. The occlusal surface of the maxillary rim may be mounted parallel to the mandibular arm of the articulator. (Fig. 10.)

The mandibular cast is attached with sticky wax to the mandibular occlusion registration plate, and the two registration plates are fastened to one another tween the occlusion rims, and the articulator mechanism is adjusted and locked so that the maxillary occlusion rim fits accurately into the imprint in the lateral registration form when this form is seated accurately on the mandibular occlusion rim. (Figs. 13 and 14.)

This operation is repeated for the right occlusion registration.

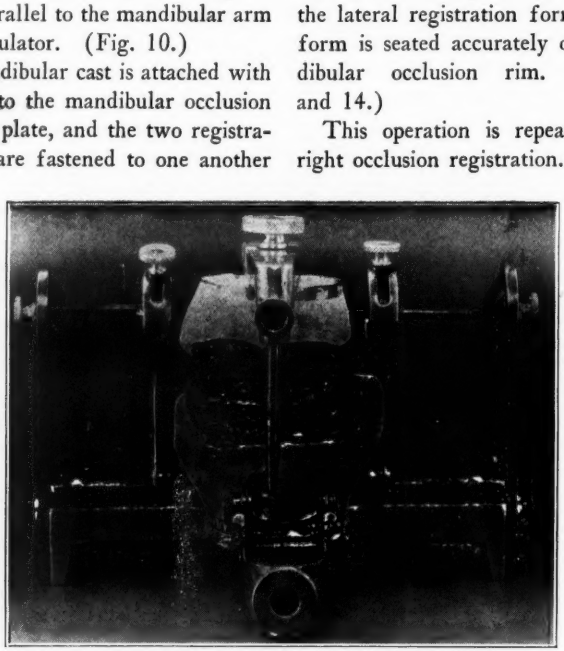


Fig. 13.—Left lateral occlusion registration in place for adjusting kinescope. The kinescope is adjusted by first setting the right descending condyle guidance to permit the maxillary occlusion plate rim to seat in the registration. If the condyle rod touches the lateral guidance plate in this operation, the plate should be set so that contact is impossible at this stage. The left condyle post is next moved inward or outward so that the ball through which the condyle rod slides is seated upon the end of the screw stud that enters the anterior end of the condyle slot. The lateral movement control, shown touching the condyle rod on the right side of the articulator, is adjusted until it touches the condyle rod lightly. It is best to repeat the foregoing sequence of adjustments, as the first setting may not be sufficiently accurate.

in central occlusion by means of the bite lock impressions and sticky wax. (Figs. 11 and 12.)

When the mounting of the casts is complete, the recording of the mandibular movements commences. The left lateral position registration is set be-

Occasionally, it is found that the protrusive registration will require a different adjustment of the descending movement control from the lateral registration. The protrusive record is taken to determine whether this is so. If a difference in setting is indicated,

the articulator is reset so as to produce the proper descending movement inclination when the articulation of the teeth is being inspected in, or perfected to, protrusive relations.

The registration plates, registration impressions and bite locks should be kept for further use, if for any reason, subsequently, new records seem necessary.

The articulation of artificial teeth should not be carried further in the simplex than is necessary to make a satisfactory test for esthetic purposes and to check up the central occlusion relation.

This method can be followed easily, if the registration plates are constructed as I have suggested.

When the dentures are vulcanized, it is usual to remount them in the kinescope. This is accomplished by making

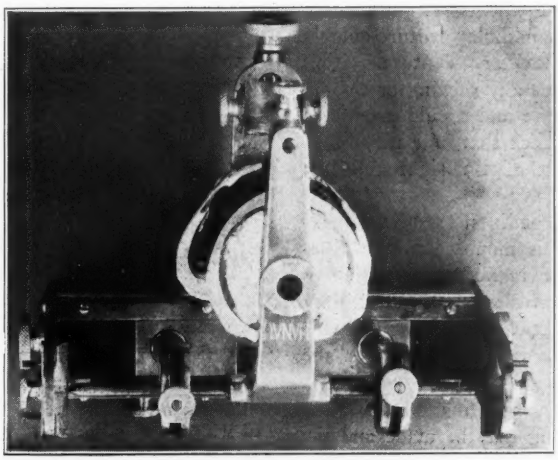


Fig. 14.—Top view of kinescope adjusted to left lateral occlusion registration.

proceeds along the same lines in this instrument as in any other. The case may, if desired, be mounted in a Gysi simplex, set up to average movements, and corrected for esthetic effects, and then remounted in the kinescope for correction of articulation to the particular movements required by the registrations of the patient for whom the case is being constructed. This will appeal to some as being more convenient, and has the advantage of permitting the working out of several cases at one time. Of course, the articulation a plaster matrix of the occlusal surface of the maxillary dentition. The matrix is attached to the mandibular bow of the articulator before the maxillary cast is removed from the articulator. The incisor guide pin should, of course, be in place so that it will support the maxillary bow of the articulator at the normal elevation.

To remount the mandibular denture in correct occlusion and in order that equalized pressure will be possible when the final grinding is finished, we proceed as follows: (1) seat the maxillary

denture in the mouth; (2) trace a small quantity of hot compound or black carding wax on the occlusal surfaces of the right and left mandibular first molars and second bicuspids. (Fig. 15.)

The patient is asked to close in central occlusion so that the cusps intermesh properly. He is also asked to exert light pressure of the same magnitude on right and left sides. The compound is chilled, and the patient opens and closes, snapping the mandibular denture quickly against the maxillary denture. This should not cause any rocking or tipping of either denture and should produce a definite clear click that indicates simultaneous contact of the right and left sides.

When this condition exists, the maxillary denture is mounted in the kinescope, and the mandibular denture is brought in occlusion to the maxillary denture with sticky wax. The mandibular denture is then attached to the articulator and ground in.

If necessary, new mandibular position registrations may be made and the kinescope readjusted to these records.

In taking registrations for the remounting of the mandibular denture, or for readjusting the kinescope after the dentures are completed, the cusps of teeth should not penetrate through the compound of the registrations.

The incisor guide incline may be arbitrarily set to produce any depth of overbite desired, but for Gysi's molars and bicuspids, carved for approximately a 30 degree inclination of condyle and incisor guide setting, it should be set for 30 degrees when the descending movement is of this magnitude, or for less than 30 degrees if the condyle movement is steeper; and vice versa, if it is less than 30 degrees. This will require the least grinding of molars and bicuspids to effect a good articulation, and is satisfactory if other conditions do not contraindicate.

The grinding of the dentures to a smooth working condition in the articulator should produce a nice balance in the mouth. However, mandibular motions are not so exact or so minutely definite as articulator motions, and it is usually good practice to have the patient chew the articulation in by placing

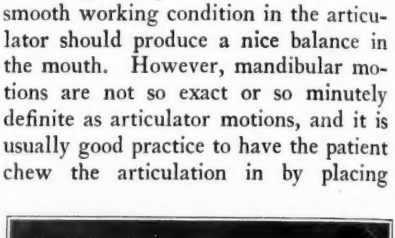


Fig. 15.—Model showing occlusal surfaces of the first molars and second bicuspids covered with compound or wax.

abrasive paste on the occluso-incisal surfaces of the mandibular denture, and to require him to chew first on the right or left, then on the reverse and finally in the incising direction. This chewing should be continuous in one direction till the movement is smooth and free of "bumps."

If the maxillary ridge is very soft, the maxillary denture should be supported in its position while mouth grinding, if it shows any tendency to rotate during masticating movements.

The chewing pressure should be just heavy enough to make grinding possible. Strong muscle action in this pro-

cedure is liable to defeat the purpose of grinding in, in the mouth.

In conclusion and in answer to an objection that is almost sure to be raised that the technic outlined is too exacting, let me say that the learning of anything worth while usually exacts a lot of effort.

If this technic seems too difficult to you, it is proof of only one thing, that you are not well suited to the field of denture prosthesis. You had best leave such work to those better adapted to it. Denture prosthesis is a most difficult branch of dentistry to excel in. It requires a great deal of patience, keen observational and reasoning powers, a good degree of mechanical ability, and at least a fair appreciation of things artistic. It requires, at times, almost impossible self-control, for, in many instances, our patients come to us in very poor shape, mentally and physically, owing to years of suffering caused by trying to wear improperly constructed appliances.

This technic follows the so-called adaptable method, which I firmly believe is the only one worth using. It agrees in principle with the method of Gysi, which I have not necessarily permanently abandoned. I have been able to secure comfort for some patients with the technic I have outlined, when the tracing method of Gysi failed, although in a relatively small number of cases. The advantage of the technic I have outlined seems to be that the records taken with the bases under slight masticating pressure record not only the movements of the mandible but also the effect of the yielding of the soft tissue to masticating pressure. The yielding of soft tissue in turn modifies the path one set of tooth cusps takes in traveling over the other set during mastication with artificial dentures, and thus we incorporate the effect of tissue resiliency on mandibular registrations, called to our attention by Mr. Hanau.

DISCUSSION

F. M. Hight, Houston, Texas: Dr. Tench spoke the truth when he said, "The most important single measurement taken in the construction of full dentures is the central occlusion relation of the mandible to the maxilla." It is a well known fact that dentures are not satisfactory where this relation is incorrect, because it is impossible to balance the occlusion without grinding away the cusps of the teeth. This step in denture technic has been sadly neglected, and is being guessed at by most of the men who make dentures. The only accurate method that is teachable or scientific is the Gysi gothic arch tracing. Dr. Tench has given you the technic as taught by Dr. Gysi, which is simple, but, I believe, not accurate enough in the hands of the majority of its users. The tracing is small, and a slight movement of the point of the path-marking pin can be overlooked because it is not in full view of the operator. I have used this technic for six years, but found that too many of my cases were built to a protruded relation. This could only be corrected by checkbites, which would place the mandible in a distal position and necessitate the grinding away of the cusps of the teeth. Figure 16 shows a simple method of enlarging the tracing and placing it in full view of the operator. An error of 0.5 mm. will result in a great deal of trouble to the patient. This amount of error is greater than one would ordinarily suppose. An example of this can be shown by mounting an upper and lower denture in the Hanau articulator, first placing a piece of paper 0.5 mm. thick between the steel balls and the stop screw. After the plaster has set, this paper is removed. The error is increased according to the steepness of the curve of Spee. Dr. Tench also points out the necessity of taking lateral checkbites without protrusion. This is easily done when the tracing is in full view of the operator. With this method, several checkbites can be taken which will give the same

reading; which is not true when we have no guide to prevent protrusion. Figure 17 shows the enlarged horseshoe plate and pathmarker cut from 18 gage hard brass.

George Phillips, Boston, Mass.: There are a few words that I should like to add which

Fig. 16.—Simple method of enlarging tracing.

may help to make the importance for the necessity of an accurate reproduction of the mandibulomaxillary relations in full denture prosthesis, clearer. To use Dr. Tench's own words, "The relations of the mandible to the maxilla in masticating movements are of the utmost importance in all dental operations." This is undeniably so; but I should like to go a little further and state that not only is a clear understanding of these relations of great importance; but also a clearer understanding of the causes responsible for the wide variation in these relations is just as imperative as the knowledge of the alphabet is in reading or spelling. It will help us to base our conception of these relations, and their final utilization in our practical work, on a foundation of facts. Once this is done, there will be an end to the swaying back and forth from one theory to another, and our work will crystallize down to good impressions, proper and consistent methods of registering and reproducing all existing mandibulomaxillary relations and, finally, the construction of the dentures. The masticatory apparatus of human beings is a complex mechanism, influenced during its development and life by many factors both inherent and extraneous. Of the inherent factors, heredity and the natural tendency toward partial and not absolute symmetry are outstanding. The extraneous causes are many, and may be enumerated as habits, malnutrition and sickness in early life, or premature loss of teeth, poor dentistry or other accidents, etc., in later life. To go one step further, in the development of the bilateral symmetry which we find in the higher forms of life, there is found a similarity of form, function and development; but in no case is there to be found an absolute sameness, which would make both halves of a developing body identical. In the mandible, as in every other one of our jointed members, whose mission is to produce movements, the main inherent cause for the lack of absolute symmetry is the independent supremacy of function each half is trying to attain. And I believe that here, in this independent development of each separate half, the various influences, whether inherent or extraneous, become instrumental in bringing about the varying degrees of asymmetry which we so often find and which are the first thing to be dealt with in denture construction. In addition to these factors mentioned, there is another

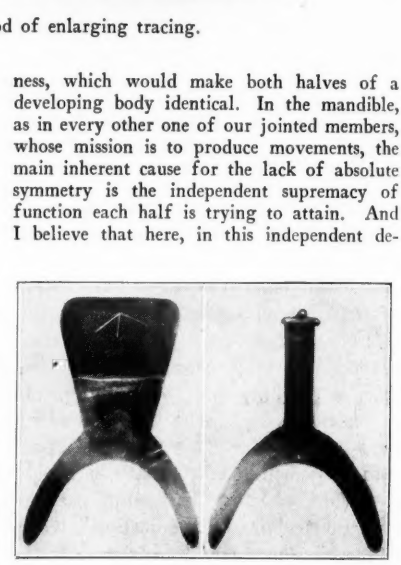


Fig. 17.—Enlarged horseshoe plate and pathmarker.

purely mechanical cause, which I find hard to classify with either of the foregoing, and that is the origin and insertion of the muscles of mastication and their relative innervation. To be brief, the point of insertion of the muscles of mastication of one side, geometrically, does not correspond with that of the other side, so that the slightest dissimilarity in the point of insertion between the corresponding halves of any pair of these muscles will create two antagonizing forces, each pulling at a slightly different angle, until the centers or pivoting points around which these muscles act will have to move into positions where these forces will be coordinated. These deductions have been arrived at after long study and experimentation, and are thoroughly approved by men of a medical teaching staff who have assisted with the experiments. With a knowledge of these fact, the necessity for their accurate reproduction on an instrument becomes absolutely essential. After the construction of dentures on an instrument that records and reproduces them accurately, any subsequent changes in these relations should be slight and negligible. This, of course, will depend on the accuracy with which the prosthetist carries out any consistent and fundamentally sound technic of denture construction. Our attention is called to the recognition of several points involved in the registration of condylar movements from lateral and protrusive bites, which no doubt meet with the approval of every one present. When it comes to the selection of an instrument for the registration of these movements and their subsequent reproduction, its range of adjustment must be so wide and delicate that when a set of dentures are constructed on it, there should be little need of after-grinding or none at all. When the dentures are completed and placed in the mouth, the operator, with his fingers placed on both sides of the upper and lower dentures, and with the patient going through the regular chewing movements, should detect no tendency toward displacement of either of the dentures. Lastly, if for some reason or other, the prosthetist should fail to get a perfect position of central occlusion in spite of the method that Dr. Tench advocates, that should be no source of discomfort to the patient and should not detract from the efficiency of the dentures. I mention this simply to emphasize the necessity for an instrument of accurate and fine adjustments, and I do not want to be misunderstood as advocating careless methods in taking occlusal relations. The technic that is outlined and advocated, although exacting, is by no means impossible, and could be adopted not only by prosthetists, but also by every general practitioner who likes to construct dentures, and its adoption, with a little thought, patience and conscientious effort, should bring excellent results.

ARTICULATION DEFINED, ANALYZED AND FORMULATED*

By RUDOLPH L. HANAU, Buffalo, New York

I do not like the obscure thought. I like to see the plain truth brought directly out upon the page, devoid of all that camouflage which many poets use. So I, who have no wish to mystify, will always call a spade a spade. There are no tricks about my trade. I am a poet whose appeal is made direct. I'll not conceal my thoughts beneath some pretty phrase that can be read in different ways. I'll not dress up the things I say to suit the fashion of the day. And so, unless you're satisfied with simple truth, then cast aside this little book, because in it you'll surely find some verse to fit the thought that your pet idol may, like all the rest, have feet of clay—*Owen White.*

OF several hundred prosthetic dentures checked up during the past three years, about 95 per cent were judged unsatisfactory by their own makers or brother dentists, after being tested and checked. Of the 95 per cent unsatisfactory dentures, more than half were dismal failures, if balanced articulation was the object. I shall repeat similar tests in a clinic scheduled for this convention.

Figures 1 and 2 also make us realize that the situation is serious. Natural, accidental and habitual causes account for anatomic deficiencies, the condition of the individual being more or less responsible. This does not apply to afflictions due to the ill-fitting dentures tested. Figure 3 gives us an idea of the bewildering complications invited by "missing the bite."

*Read before the Section on Full Denture Prosthesis at the Sixty-Seventh Annual Session of the American Dental Association, Louisville, Ky., Sept. 24, 1925.

Endless is the number of criticisms that have been applied to the situation, which is worse than we care to admit. Numerous are the remedies suggested for eliminating the evil of malarticulated dentures.

After all, there is only one course which promises success. It leads via the desire to experience, learn, analyze, understand and apply. If the cycle is repeated many times, we will realize that still more is to be learned.

I have no simple appearing analysis of articulation to offer you. I know of none that is simple and correct. I know of many that are said to be both, but are neither. I have knowledge of a few that are logical and correct in part. The proven facts of my precursors, not their claims, are the premises of this presentation.

The establishment of balanced articulation is a mere matter of recognizing the conditions and of applying mental and physical adroitness, in order to reach a known goal. Incidentally, we also need proper tools, instruments and materials with which to work.

The anatomic masticatory apparatus is intended to triturate foods without trauma. Technically, we may say, the masticatory surfaces should operate smoothly, without interference. Smooth operation is secured by giving the numerous co-acting surface fragments of the masticatory surfaces suitable distribution, suitable diameters and suitable directions, so that a balanced contact is

maintained during function. The maintenance of balanced contact of the masticatory surfaces (balanced occlusion during function) is designated as balanced articulation.

ARTICULATION DEFINED

Articulation is the change from one occlusion to another occlusion while the masticatory surfaces maintain contact.

Natural articulation is articulation of natural or prosthetic dentures conforming to accepted physiologic requirements for comfort and efficacy.

Unnatural articulation is an articulation of natural or prosthetic dentures not conforming to accepted physiologic requirements or to individual requirements of a case, because of limitations or abnormalities.

Anatomic articulation infers the articulation of natural dentures in the mouth.

Prosthetic articulation infers the articulation of prosthetic dentures in the mouth, individual occlusions being associated with analogous jaw relations.

Semiprosthetic articulation infers the articulation of prosthetic dentures in the mouth, individual occlusions not always being associated with like jaw relations.

Ordinary articulation is an articulation complying with accepted laws of articulation. Ordinary articulation is always balanced within admitted resilient limits.

Malarticulation is articulation not complying with accepted laws of articulation. Malarticulation lacks balance, *in toto* or in part, of function.

Mixed articulation infers balanced articulation to and from centric occlusion during part of the masticatory stroke only. Rather frequently, mixed articulation is found in natural dentures. If the balanced articulation is confined to the initial part of articulation from centric occlusion of a natural denture, then, with our present understanding of anatomic articulation, it should not be defined as malarticulation. It seems more appropriate to describe the unbalanced continuation of articulation in the incisal region of natural dentures with overarticulation. Mixed articulation is malarticulation for prosthetic dentures.

Balanced articulation is the change from one balanced occlusion to another while the masticatory surfaces remain in balanced contact. Balanced articulation complies with accepted laws of balanced articulation.

Unbalanced articulation is the change from one occlusion to another while the masticatory surfaces maintain contact, but balance is interrupted or lacking. Unbalanced articulation does not comply with accepted laws of balanced articulation. Unbalanced articulation induces a patient to perform malarticulation, if he accepts it at all. It invariably forces the patient, if he tolerates it, to acquire the habit of performing unnatural articulation and to seek for rest positions along the lines of least resistance and least discomfort.

Strained articulation is function while forces act, namely, when pressure is applied.

Unstrained articulation is function when no forces act; namely, when pressure is not applied.

Balanced anatomic articulation is a change of natural dentures from one balanced occlusion associated with an analogous jaw relation to other corresponding associations, while the masticatory surfaces remain in contact.

It has been claimed by some that a natural denture, balanced throughout

its effective masticatory range, is the normal, if centric occlusion of the masticatory surfaces is associated with protrusive relation of the jaws. That may be so. It has not been convincingly demonstrated to me, though it is conceded that the mandible is able to carry the masticatory surfaces into a retruded position under strain.

Balanced prosthetic articulation is a change of prosthetic dentures from one balanced occlusion associated with an analogous jaw relation into other corresponding associations, while the masticatory surfaces maintain contact.

Balanced semiprosthetic articulation is a change of prosthetic dentures from one balanced occlusion not always associated with analogous jaw relation to other corresponding associations, while the masticatory surfaces maintain contact.

FACTORS GOVERNING ARTICULATION

A. *Condyle Guidance.*—This includes (1) anteroposterior guidance (horizontal inclination); (2) lateral guidance (sagittal inclination), and (3) lateral aberration. All movements of the condyle heads are accepted as starting in the socket and returning to it. Three distinct excursions of the condyle head in the condylar fossa are of particular interest: (1) the forward and downward directed excursion along the protrusive guidance, the inclination of which is expressed by the angle to a horizontal plane (horizontal inclination); (2) the forward, downward and inward directed excursion on the balancing side along the lateral guidance, the inclination of which is referred to the sagittal plane (saggital inclination), and (3) the lateral excursion on the working side, the lateral aberration which deviated slightly from a perpendicular to the sagittal plane.

B. *Tooth Alinement.*—The outstanding features of tooth alinement are the arch form, the compensating curve and the buccolingual inclination of the posterior teeth. The importance of the labiolingual inclination of the anterior teeth is amply recognized by their special consideration as an incisal guidance.

A tooth alinement is characterized as horizontal, vertical and frontal projection. The same applies to sections of alinement and to individual teeth. The accepted anatomic terms, such as buccolingual, mesiodistal and their reverse, are equivalents.

C. *Incisal Guidance.*—This includes a consideration of (1) labiolingual inclination (protrusive, horizontal or anteroposterior guidance), and (2) sagittal inclination (lateral guidance). The mandibular incisors, including the cuspids, may be considered one large cusp having a curved ridge. The labial and lingual surfaces are of no particular interest mechanically. Analogously, we will accept the maxillary incisors, including the cuspids, as a large sulcus, of which the lingual surface becomes a guiding wall (posterosuperior surface of the bicuspoid), and the incisal edge surface itself, a guiding surface (anterosuperior surface of the bicuspoid). With this simile in mind, the incisal guidance is reduced to the simplicity of an ordinary cusp guidance with its protrusive and bilateral guiding surfaces.

D. *Relative Cusp Height.*—This subject includes (1) the cusp guidance incline for the protrusive bite; (2) cusp guidance incline for the lateral on the working side, and (3) cusp guidance incline for the lateral on the balancing

side. The cusp height is only relative, if we compare it with its "basal radius," which is the projection on the cusp base of the movement of a point directed along the incline from the base to the cusp summit. Strictly, we should in each case speak of the inclination and magnitude of a guiding path or line and refer dimensions and projections to the planes of one accepted coordinate system.

Cusp height is the conventional term and, being descriptive, will be adhered to in expressing the laws of articulation. The laws of articulation express the modification of the cusp height by one factor at a time. A change of cusp height, without modification of cusp base, is the object of grinding a chosen tooth. It is the customary operation required. The selection of a larger or smaller tooth will ordinarily change the base. The consequences are readily traceable by the application of elementary geometry.

With the foregoing in mind, we may without detriment to succinctness, speak of a "relative cusp height" and apply our deductions also to the guiding cusp incline under consideration.

E. *Position of Triangle of Orientation (Denture Position).*—This includes a consideration of (1) the distance of the central incisal contact point from the condyle line; (2) the distance of the central incisal contact point from the sagittal plane, and (3) the rotation of the triangle of orientation about its axes through the central incisal contact point: (*a*) the horizontal lateral axis; (*b*) the horizontal anteroposterior axis, and (*c*) the vertical axis.

The triangle of orientation is accepted in the plane of orientation, which is a plane through the central incisal contact point and the occlusal terminations of the second molar buccal grooves. These three points are the three corners of the triangle of orientation through which we may lay a plane of orientation. No distinction is made between the maxillary and the mandibular triangle of orientation. The angle beween the two ordinarily is comparatively small.

There are quite a number of additional factors governing the establishment of articulation of the teeth. Some of these factors are of vital importance to the classification and standardization of tooth molds.

ARTICULATION

We must know the laws of articulation, in order to understand the intricacies of articulation, and if we have the desire to apply and discuss them scientifically. Some of these laws are of such fundamental significance that those who confine themselves to setting up of teeth only should know them for their own convenience.

Articulation is a purely mechanical function and as such must be investigated and explained by geometry, cinematics and mechanics. A correctly adjusted articulator is a secure indirect guide to show the skilled operator when he is right or wrong. Then he will reason rather than apply unnecessary time to experiments.

The laws of articulation express the reciprocal influence of the factors governing articulation. The character of these factors does not permit the setting up of a succinct collective formula as is done, for instance, in hydrodyamics and electrotechnics.

I shall therefore follow the line of least resistance by relating only two factors at a time, accepting that, while

I do so, all other factors remain unchanged.

It is assumed that guidances have the required magnitude and that esthetics and phonetics are taken care of independently.

The key chart shown in the accompanying table will serve to facilitate finding a law of articulation relating any two single factors. The intersection of a vertical and horizontal column contains the key numbers that precede the particular law.

THE LAWS OF BALANCED ARTICULATION[1]

All laws of articulation may be transformed as shown by examples given in the key to the quint. Certain laws referred to the anatomy become misleading, if not applied with discretion, because we accept the fact that we articulate teeth to conform to anatomic conditions, transferred, measured and established. The change of a factor from the real to the ideal calls for modifications of accepted dental conceptions. The resultant modifications are interesting from a mathematical point of view only; but they are about as unimportant to practitioners as are the square roots of minus values to physicians.

The influence of one factor on another, assuming that all other factors remained unchanged, is:

1. An increase in steepness of the horizontal condyle inclination on one side:

1:2 increases the prominence of the compensating curve on the same side and to a small degree also on the other side.

1:3 decreases the steepness of the protrusive incisal guidance.

1:4 tends to incline the plane of orientation upward toward the posterior (anatomic limitation).

1:5 increases the buccolingual inclination of the tooth axes progressively toward the posterior on the same side and decreases them in a lesser degree on the other side.

1:6 is an existing anatomic relation to the sagittal condyle inclination ($L^0 = (A_s{}^0$ plus $12^0)$ plus or minus 3^0 for the Hanau articulator, Model H).

1:7 decreases the steepness of the sagittal incisal guidance on the other side.

1:8 tends to modify the upper tooth alinement toward the square type and the lower toward the tapering type.

1:9 increases the relative cusp height progressively toward the posterior on the same side and in a small degree also on the other side.

2. An increase of the prominence of the compensating curve on one side:

2:3 increases the steepness of the protrusive incisal guidance.

2:4 tends to decline the plane of orientation toward the posterior on the same side and in a lesser degree on the other side.

2:5 decreases the buccolingual inclinations of the tooth axes toward the posterior on the same side and increases them in a lesser degree on the other side.

2:6 is the consequence of a decrease of the sagittal condyle inclination on either side.

1. These laws were formulated without experimental data on hand. They should be carefully rechecked by investigators. The original draft of these laws was modified after consulting with Drs. A. E. Boyce, C. J. R. Engstrom, F. W. Frahm, R. R. Gillis, Alfred Gysi, A. A. Nelson, R. O. Schlosser, Victor H. Sears and W. H. Wright.

2:7 increases the steepness of the sagittal incisal guidance on the other side.

2:8 tends to modify the upper tooth alinement toward the tapering type and the lower toward the square type.

2:9 decreases the relative cusp height progressively toward the posterior

3:7 increases the steepness of the inclination of the sagittal incisal guidance.

3:8 tends to modify the upper tooth alinement toward the tapering type and the lower toward the square type.

3:9 increases the relative cusp heights progressively to the anterior.

KEY CHART TO LAWS OF ARTICULATION

KEY* *To find the law of articulation which relates two single factors see paragraph corresponding to the numbers given in the intersection of respective factor columns. The reversals are listed in parenthesis.	Horizontal condyle inclination	Compensating curve	Protrusive incisal guidance	Plane of orientation	Buccolingual inclination of tooth axes	Sagittal condyle inclination	Sagittal incisal guidance	Tooth alignment	Relative cusp height
Horizontal condyle inclination		1:2	1:3	1:4	1:5	1:6	1:7	1:8	1:9
Compensating curve	(2:1)		2:3	2:4	2:5	2:6	2:7	2:8	2:9
Protrusive incisal guidance	(3:1)	(3:2)		3:4	3:5	3:6	3:7	3:8	3:9
Plane of orientation	(4:1)	(4:2)	(4:3)		4:5	4:6	4:7	4:8	4:9
Buccolingual inclination of tooth axes	(5:1)	(5:2)	(5:3)	(5:4)		5:6	5:7	5:8	5:9
Sagittal condyle inclination	(6:1)	(6:2)	(6:3)	(6:4)	(6:5)		6:7	6:8	6:9
Sagittal incisal guidance	(7:1)	(7:2)	(7:3)	(7:4)	(7:5)	(7:6)		7:8	7:9
Tooth alignment	(8:1)	(8:2)	(8:3)	(8:4)	(8:5)	(8:6)	(8:7)		8:9
Relative cusp height	(9:1)	(9:2)	(9:3)	(9:4)	(9:5)	(9:6)	(9:7)	(9:8)	

The consideration of a tenth factor adds nine new laws of articulation. The nth factor adds (n—1) laws. The total number of laws for "n" factors equals: $\frac{n\,(n-1)}{2}$

on the same side and in a lesser degree on the other side.

3. An increase of the steepness of the protrusive incisal guidance:

3:4 tends to increase the steepness of the inclination of the plane of orientation toward the posterior.

3:5 increases the buccolingual inclinations of the tooth axes toward the posterior.

3:6 is a consequence of an increase of the sagittal condyle inclination.

4. An increase of the inclination of the plane of orientation toward the posterior:

4:5 increases the steepness of the buccolingual inclinations of the tooth axes.

4:6 is the consequence of decreasing sagittal condyle inclination.

4:7 increases the steepness of the sagittal incisal guidance.

4:8 tends to modify the upper tooth alinement toward the tapering

type and the lower toward the square type.

4:9 decreases the relative cusp heights equally (or nearly so).

5. An increase of the buccolingual inclination of the tooth axes toward the posterior on one side:

5:6 is the consequence of a decrease of the sagittal condyle inclination on the same side or of an increase of the sagittal condyle inclination on the other side.

5:7 increases the steepness of the sagittal incisal guidance on the other side.

5:8 tends to modify the upper tooth alinement toward the square type and the lower toward the tapering type.

5:9 decreases the relative cusp heights of the teeth inclined.

6. An increase of the sagittal condyle inclination on one side:

6:7 increases the steepness of the sagittal incisal guidance on the other side.

6:8 tends to modify the tooth alinements toward the tapering type.

6:9 decreases the relative cusp heights on both sides progressively to the posterior.

7. An increase of the steepness of the sagittal incisal guidance:

7:8 tends to modify the upper tooth alinement toward the square type and the lower toward the tapering type.

7:9 increases the relative cusp heights on both sides progressively toward the anterior.

8. A modification of the upper and lower tooth alinements toward the tapering type:

8:9 decreases the relative cusp heights progressively toward the anterior.

The widespread opinion that different fundamental principles of mechanics apply to the generation of the masticatory surfaces in order that they may conform to accepted modes of articulation is erroneous. The fundamental laws involved are practically alike for orthodontic, periodontic, crown, bridge, partial and full denture work, though the manipulations in their application differ. The range of application of these laws covers more than ordinary needs.

While we are concerned in this paper primarily with the correct application of mechanics, it is important that the mechanics be in compliance with physiologic requirements, and I wish to emphasize the necessity of coordinating the mechanical and physiologic requirements. They are of equal importance.

The scientific value of these laws of articulation is made readily appreciable by use of the articulation quint, which greatly facilitates their practical application. The quint gives a combination of the most essential laws of articulation in convenient form. Each fifth represents a factor undergoing a change. The changes indicated are accompanied by heavy arrows. The light arrows in each fifth refer to the other factors. The directions of the light arrows indicate the sense in which to read the influence of a respective factor on the factor they identify. (Fig. 4.)

The solution of the problem of establishing articulation in the mouth and its explanation had been sought in the past, by the following means: (1) the development of devices which resembled the anatomic apparatus in form only; (2) the building of arbitrary mechanisms with arbitrarily accepted dimensions and functions; (3) the introduction of instruments for accepted

averages and ideals of dimensions and functions; (4) the developing of methods for measuring and recording anatomic dimensions and transferring them to adjustable instruments.

With the development of instruments, the function of the anatomic apparatus became more clearly understood. It led to the articulator of Walker, to Christensen's wax bite technic and to the articulator technic and analysis of articulation by Gysi. Their pioneer work incorporates many basic principles which I accept with simple modifications.

Closely following Gysi, various efforts were again made to explain articulation by peculiar and novel theories and mechanisms. These efforts evidenced the fact that the interpretation of articulation was lacking, rather than a novel mechanism to establish it.

We now have concise methods of measuring, and accurate instruments, which permit consideration not only of the dimensions but also of functional peculiarities, due to the resilient effect of the supporting tissues.

We also have an understanding of desirable occlusions, jaw relations, and articulation and means for establishing them accurately.

I am fully aware that the most thorough understanding and the most perfect application of my present recommendations are not all that makes a good denture restoration. These two items are only links in a long chain of requirements, but they are strong links.

The situation today is a happy one. The problem of establishing balanced articulation in the mouth is no more a mystery beclouded by questionable theories. It has been analyzed and solved.

Subject to the given definitions, articulation, generally speaking, is occlusion associated with relations in function. Articulation is natural or unnatural, and, in addition, is anatomic, prosthetic or semiprosthetic. Depending on the properties, balanced, mixed or unbalanced, we have them classified as ordinary articulation and malarticulation. Such cross-classification permits very fine differentiation.

In Figure 1, the upper half of the chart is so arranged that the shortest circuit, using the dashed line on the side where we start as the return, determines all the properties of an articulation. For instance, anatomic articulation, as here understood, becomes unnatural if unbalanced, because unbalanced anatomic articulation is malarticulation; from which it will be noted in the chart that a dashed line leads back to articulation. Likewise, unnatural articulation cannot be balanced anatomic articulation because we would have to return via ordinary articulation on the dashed line on the left, which is located opposite to unnatural articulation. On the other hand, it will be noted that any articulation which is balanced becomes an ordinary articulation, etc.

The lower half of the chart analyzes ordinary articulation with consideration of the association of occlusions and jaw relations, and finally contracts the eight possibilities into four groups.

Figure 2 is an analysis of articulation from a point of view different from that of Figure 1. Occlusion and jaw relations were analyzed similarly on a previous occasion.

Within the square are accepted all kinds of articulations we may possibly think of, and of these the ordinary relations are confined within the circle. The area outside the circle, but within the square, represents the area for malarticulation. Each of the four horseshoe-like figures present properties of articulation; namely, balanced, unbalanced, strained and unstrained. In addition, we find the property "mixed" shown by a Z-shaped area. The balanced, unbalanced and mixed areas are so arranged that they partly overlap the ordinary articulation and malarticulation as well as the strained and unstrained areas. All areas are so arranged that their single or multiple overlaps designate hypothetical, but not necessarily acceptable, combinations.

We may derive the following triple combinations:

(1) balanced unstrained ordinary articulation; (2) unbalanced unstrained ordinary

articulation; (3) mixed unstrained ordinary articulation; (4) balanced strained malarticulation; (5) unbalanced strained malarticulation; (6) mixed strained malarticulation; (7) balanced strained ordinary articulation; (8) unbalanced strained ordinary articulation; (9) mixed strained ordinary articulation; (10) balanced unstrained mal-

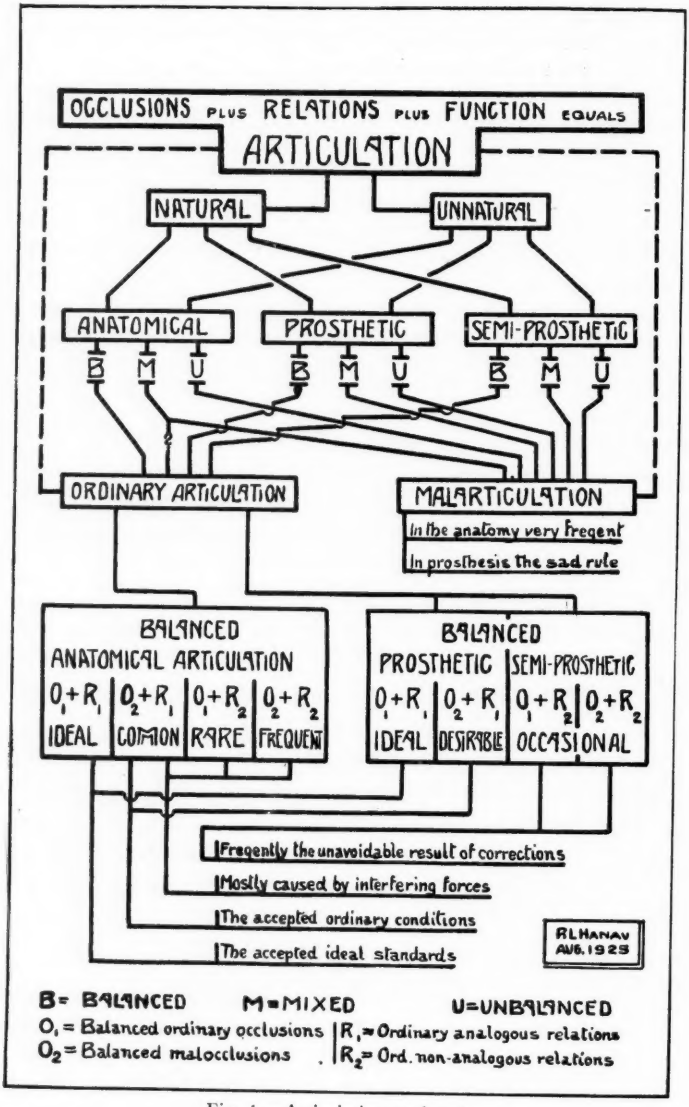


Fig. 1.—Articulation analyzed.

articulation; (11) unbalanced unstrained malarticulation, and (12) mixed unstrained malarticulation.

Combinations 2, 4, 8 and 10 are contradictory to the proposed definition and therefore eliminated. Combinations 5, 6, 11 and 12 are redundant superlatives of the articulations we should at all times avoid, 6 and 12 being in addition misleading expressions. Combinations 3 and 9 are unsettled issues. Thus balanced unstrained articulation (1) and balanced strained articulation (7) remain. These two combinations only, at this time, are here recommended as the ideal standards, which acceptable conditions must approach.

In Figure 3, unstrained centric relation is accepted as the natural starting position of all mandibular excursions. Retruded relations are accepted to occur under application of biting force accompanied by displacement or possibly compression of tissues, inviting undue tissue changes, if carried beyond physiologic toleration. Retruded relations of columns 2, 8 and 9 are equivalent to strained relations of columns 1, 4 and 5, respectively.

It shall be agreed to refer all "bites" to the existing occlusion associated with centric relation as a starting position.

Example: "Retrusive occlusion associated with centric jaw relation" and not "protruded jaw relation associated with centric occlusion," though the expressions are synonymous. The first mode of expression permits succinct tabulation and makes investigation clearer. Likewise, we say, "left lateral occlusion associated with centric jaw relation," etc. Various occlusions associated with centric jaw relation are differentiated by capitals.

The index "o" in A_o, B_o, C_o, D_o, etc., indicates the starting association of an occlusion with a jaw relation and as such is considered (irrespective of the magnitude of "missing-the-bite") in the horizontal column.

The index "1" in A_1, B_1, C_1, D_1, etc., in a vertical column, denotes the occlusion into which the masticatory surfaces are brought immediately after leaving the starting positions A_o, B_o, C_o, D_o, etc., during the stroke into the relation designated by the respective vertical relation column. The complete stroke into the respective relation is always accepted to carry all points along straight lines. The masticatory surfaces may be carried through various occlusions. These occlusions, in sequence from their starting positions, are indicated by the indices "0, 1, 2, 3, 4, 5" or "o, a, b, c, d, e" or "o, I, II, III, IV, V" or "o, A, B, C, D, E." One, two or more series of indices are used to differentiate the consequences of possible linear strokes deviating in direction from the starting position, or of possibilities created by various magnitudes of "missing-the-bite."

The starting position, the direction and the magnitude (or either) of a mandibular excursion may enlarge, limit the number of occlusions passed through or be responsible for an entirely different array of occlusions.

Example 1.: A_o presents centric occlusion associated with centric relation. A_1 appears

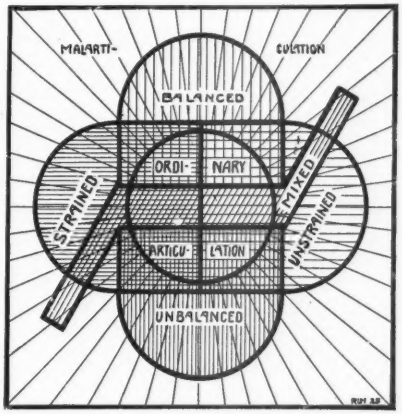


Fig. 2.—Analysis of articulation.

at the intersections of the vertical (or relation) and like horizontal (or occlusion) columns. No indices besides "o" and "1" are attached to "A." This means that occlusions are associated with like relations.

Example 2.: B_o represents retrusive occlusions (horizontal column) associated with centric relation (vertical column), the starting association. As soon as the mandible protrudes from centric relation, the occlusions change from retrusive occlusion, the starting occlusion B_o, to a less retruded occlusion B_1, than to centric occlusion B_2, and finally to protrusive occlusion B_3. Similarly, we may follow up all relations into which the mandible is brought, when moved from any other starting association. We will find the consequent occlusion or occlusions into which the masticatory surfaces are brought, in the

OCCLUSIONS AND RELATIONS ASSOCIATED BY R.L.HANAU AVG 1925	RELATIONS OF THE MANDIBLE TO THE MAXILLAE								
OCCLUSIONS OF THE MASTICATORY SURFACES	1. CENTRIC	2. RETRUDED (OR STRAINED CENTRIC)	3 PROTRUDED	4. LEFT LATERAL	5. RIGHT LATERAL	6. PROTRUDED LEFT LATERAL	7. PROTRUDED RIGHT LATERAL	8. RETRUDED (OR STRAINED) LEFT LATERAL	9. RETRUDED (OR STRAINED) RIGHT LATERAL
CENTRIC	A_o	$A_o C_b$	$A_o B_a$	$A_o K_b$	$A_o H_b$	$A_o K_b$	$A_o H_b$	$A_o G_b$	$A_o F_b$
RETRUSIVE	B_o	$A_1 B_o B_1 C_c$	$B_o B_1$	$B_o K_2$	$B_o H_2$	$B_o K_2 K_B$	$B_o H_2 H_B$	$B_o E_2 G_{II} K_2$	$B_o D_2 F_{II} H_2$
PROTRUSIVE	C_o	$C_o C_1 C_a$	$A_1 B_3 C_o C_1$	$C_o E_2 G_2 K_{IV}$	$C_o D_2 F_2 H_{IV}$	$C_o E_2 G_2 K_4$	$C_o D_2 F_2 H_{IV}$	$C_o G_2$	$C_o F_2$
LEFT LATERAL	D_o	$D_o F_b F_{II}$	$D_o H_2$	$A_1 D_o D_1 K_c$	$D_o H_2$	$B_b D_o H_b K_D$	$D_o H_2$	$C_2 D_o F_2 G_4$	$D_o F_{II}$
RIGHT LATERAL	E_o	$E_o G_b G_{II}$	$E_o K_2$	$E_o K_{II}$	$A_1 E_o E_1 H_c$	$E_o K_{II}$	$B_b E_o H_D K_b$	$E_o G_{II}$	$C_2 E_o F_4 G_2$
PROTRUDED LEFT LATERAL	F_o	$F_o F_1 F_a F_I$	$D_1 F_o F_1 H_3$	$C_1 E_3 F_o F_1 G_3 K_V$	$D_1 F_o F_1 H_{III}$	$A_1 B_c C_1 D_1 E_3 F_o F_1 G_3 H_c K_E K_c K_V$	$D_1 F_o F_1 H_{III}$	$C_1 F_o F_1 G_3$	$F_o F_1 F_a F_I$
PROTRUDED RIGHT LATERAL	G_o	$G_o G_1 G_a G_I$	$E_1 G_o G_1 K_3$	$E_1 G_o G_1 K_{III}$	$C_1 D_3 F_3 G_o G_1 H_V$	$E_1 G_o G_1 K_{III}$	$A_1 B_c C_1 D_3 E_1 F_3 G_o G_1 H_E H_c H_V K_c$	$G_o G_1 G_a G_I$	$C_1 F_3 G_o G_1$
RETRUDED LEFT LATERAL	H_o	$D_1 F_{III} H_o H_1$	$H_o H_1$	$B_1 H_o H_1 K_3$	$H_o H_1 H_a H_I$	$B_1 B_a H_o H_1 H_a K_3 K_C$	$H_o H_1 H_a H_I H_A$	$A_1 B_1 C_3 D_1 E_3 F_3 G_5 G_c G_I H_o H_1 K_3$	$D_1 F_{III} H_o H_1$
RETRUDED RIGHT LATERAL	K_o	$E_1 G_{III} K_o K_1$	$K_o K_1$	$K_o K_1 K_a K_I$	$B_1 H_3 K_o K_1$	$K_o K_1 K_a K_I K_A$	$B_1 B_a H_3 H_c K_o K_1 K_a$	$E_1 G_{III} K_o K_1$	$A_1 B_1 C_3 D_3 E_1 F_5 F_c F_V G_3 H_3 K_o K_1$

Fig. 3.—Chart Showing Associations of Occlusions and Relations.

vertical column designating the relation into which the mandible is to be brought.

Example 3.: D_0 presents left lateral occlusion associated with centric relation. The mandible is to make a protruded left lateral excursion. D_0 is found at the intersection of left lateral occlusion and protruded left lateral relation merely to recall the starting position; D_1 is found in the horizontal column for protruded left lateral occlusion. No further "D" being found in the vertical column, signifying the relation into which the stroke is executed, we deduct: A denture in which left lateral occlusion is associated with centric relation is carried into protruded left lateral occlusion, when the mandible makes a protruded left lateral excursion. Now, we may also wish to know what happens to D_0 in a right lateral excursion. We find in the fifth vertical column: D_0, D_1, D_2, D_3, which is to be read: The occlusions change from the starting occlusion, which is left lateral, to protruded left lateral, to protrusion and finally to protruded right lateral occlusion.

Example 4.: Still more interesting becomes an investigation of the association "H", when the mandible moves into the protruded right lateral (vertical column 7). Here, we find H_0 symbolic for starting positions with various magnitudes of missing-the-bite. The following results are recorded: H_0, H_1, H_2, H_3; H_0, H_a, H_b, H_c; H_0, H_I, H_{II}, H_{III}, H_{IV}, H_V; H_0, H_A, H_B, H_C, H_D, H_E. Each series presents a sequence of occlusions the dentures have to pass through. Not only the starting position, but also the magnitudes and directions of the excursions are responsible for the variance.

A careful study of the table is recommended as a most profitable step in coping with mandibular problems. The deductions from this table apply to all branches of dental specialization.

Figure 4 is the articulation quint, coordinating the ten main laws of articulation. It records the influence of one factor, governing the establishment of balanced articulation, one other factor, while the remaining factors remain unchanged. Each fifth of the quint represents a factor; the change is indicated on the centric, heavily drawn arrow. It shall be understood that the direction of each individual heavy arrow characterizes the change of the factor indicated in the respective fifth. A reversed arrow is a request to reverse the change.

Example: "Increasing prominence of the compensating curve," which is read in the upper right fifth. The reverse is a "decreasing prominence of the compensating curve." The heavy, centric arrows are topped by a capital letter. Referring to the fifth mentioned, we find "C" attached to the centric arrow. On each side of every centric arrow, we find two less conspicuous arrows, individually identified by capital letters of the remaining fifths. The meaning of the arrangement may be inferred from the following two problems:

1. What is the influence of the incisal guidance on the compensating curve, all other factors remaining unchanged?

Solution: Incisal guidance (lower left corner); D-arrow, pointing centrifugally, stands for "increasing horizontal inclination of the incisal guidance." The fifth for the compensating curve (upper right) is identified by "C." Returning to the D-fifths, we find the small arrow marked "C" also pointing centrifugally. For such direction of the arrow, we read "C": "increasing prominence of the compensating curve." Merging the two findings into a sentence, we read: An increasing horizontal inclination of the incisal guidance (D) increases the prominence of the compensating curve (C).

2. What influence does the condylar guidance exert on the relative cusp height (all other factors remaining unchanged)?

Solution: Condylar guidance "A"; relative cusp height "E." We note that the small arrow "E" in the A-fifth points centripetally, which means that "E" should be read in the reverse in connection with "A." Instead of "decreasing of the relative cusp height," we must now read: "increasing of the relative cusp height." Hence the law: An increase of the horizontal inclination of the condylar guidance increases the relative cusp height; progressively to the posterior, we add, to be concise.

For the purpose of facilitating the study and ultimate practical application of the quint, the laws of articulation which it embraces are herewith recorded. Their transformations are self evident from the example following later. A. An increase of the horizontal inclination of the condylar guidance: A:B tips down the plane of orientation to the posterior; A:C increases the prominence of the

Fig. 3.—Chart Showing Associations of Occlusions and Relations.

compensating curve; A:D decreases the horizontal inclination of the incisal guidance; A:E increases the relative cusp heights to the posterior. B. The tipping down to the posterior of the plane of orientation: B:C increases the prominence of the compensating curve; B:D decreases the horizontal inclination of the incisal guidance; B:E increases the relative cusp height equally (or nearly so). C. An increase of the prominence of the compensating curve: C:D increases the horizontal inclination of the incisal guidance; C:E decreases the relative cusp height progressively to the posterior. D. An increase of the horizontal inclination of the incisal guidance: D:E increases the relative cusp height progressively to the anterior and their transformations.

Example showing transformations of C:D: C:D (positive): An increase of the prominence of the compensating curve increases the horizontal inclination of the incisal guidance. C:D (negative): A decrease of the prominence of the compensating curve decreases the horizontal inclination of the incisal guidance. D:C (positive): An increase of the horizontal inclination of the incisal guidance increases the prominence of the compensating curve. D:C (negative): A decrease of the horizontal inclination of the incisal guidance decreases the prominence of the compensating curve. C:D (positive), C:D

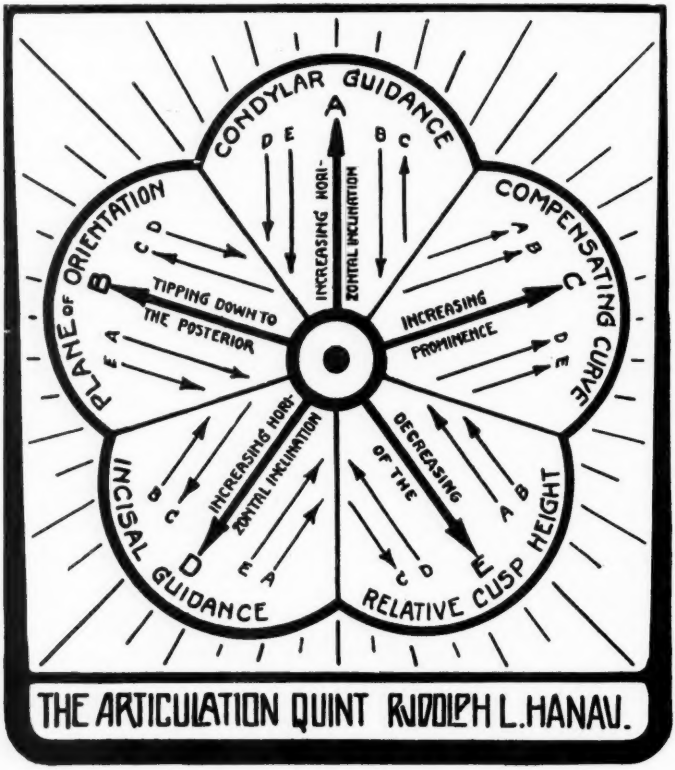


Fig. 4.—Articulation quint.

(negative), D:C (positive), D:C (negative) are tantamount laws. When one law is mentioned, it should always be understood that its transformations also apply.

DISCUSSION

R. O. Schlosser, Chicago, Ill.: Mr. Hanau begins his paper with a rather broad statement, one which many in a professional audience such as is gathered here might readily resent; yet after a careful perusal of the entire paper, and knowing Mr. Hanau quite intimately and being one of many who have submitted cases to be tested and checked, I am forced to admit that Mr. Hanau has but told us the truth. If the truth as he has placed it before us has, so to speak, gotten under our hides and, because of his persistence, we feel more or less chafed, let me assure you that our condition is as the proverbial "bed of roses" when compared to the misery and torture we have inflicted on our unsuspecting patients by placing into their mouths maloccluded, malrelated and malarticulated dentures. Let us therefore refrain from any attempt to recognize in this paper anything that could be construed as a personal affront to our professional dignity but rather let us accept it as a beneficial counterirritant which shall stimulate us to renew our efforts and improve the service we render our edentulous patients so that it may become truly professional in the full acceptance of that term. Having accepted the counterirritant, we must concede that Mr. Hanau has also proffered a remedy for some of our ills, and though, as he suggests, we may not find it an easy one to take, it will require but a short treatment to convince us that in it we shall find much alleviation. I quote "the desire to experience, learn, analyze, understand and apply." Let us study his definitions, check up his analysis and apply them conscientiously along with such a fund of accumulated knowledge as we possess, and I am confident that we will come to appreciate fully the service Mr. Hanau has rendered to denture prosthesis by his introduction of and application of the principles of engineering, especially in the field of kinematics. To those who are familiar with Mr. Hanau's previous works, the caliber of his paper was anticipated. It bears the characteristics of clear, logical thinking, and a simplified and concise presentation of the complicated and involved factors essential to an understanding and interpretation of the latest developments in the problem of occlusions, relations and articulation and their application to dental requirements. From the men who are familiar with the work of the noted pioneers of investigation in this field will come the greatest appreciation of this paper. They will know the bulwarks upon which the hard won progress in this problem has been reared, and have witnessed the sincere yet futile efforts of those who have continually come to the front, and have been found wanting after scientific investigation and clinical observation. To those who have witnessed the long struggle in the hope that tangible results would be produced to help them solve problems in office practice, this work should be an inspiration to improve and profit, for through such efforts as this has come a better understanding and better equipment, both in theory and technic, to render better service. We will see here at this meeting clinics showing the application of many of Hanau's findings by men of outstanding merit and distinction in the profession. That men of this caliber are here giving clinics in this work should dispel any reluctance on the part of those who question its merit or acceptance. It seems to me, after careful study of the work of Hanau, and after checking up with previous knowledge, that, in teaching and practice, it is essential to consider the most recent interpretation of the subject. The technic incorporates only a few items that were not previously employed by the dental profession. This means that we do not have to cast aside the good we have gleaned from the past, but merely revise the application of what we already know. This knowledge is arranged, coordinated, simplified and improved so that the results are a marked advancement. There is at present no need for further search for a better instrument. Our technic and results are not yet abreast with the possibilities of accomplishment with those we already have. Our attention should be turned to the technic and the acquirement of sufficient knowledge so that we can intelligently apply it. This knowledge can be obtained by knowing the factors involved and their coordinated application in establishing balanced articulation. In his earlier work on the investigation of mandibular movements and their reproduction in the articulator mechanism, Hanau says: "No so-called anatomic, automatic or adjustable articulator will fill the gap which

has to be bridged by concentrated analytic and constructive thinking." That is only too true. It is quite evident to those who have worked with the Gysi adaptable, the Hanau H and the Hanau kinescope that these instruments are of outstanding merit, as clinical tests have adequately proved. Particularly with the latter two are we given an accurate and practical technic. While the articulator and technic supply the practical basis, Mr. Hanau's paper supplies the theoretical basis, which enables the competent dentist to meet with ease and precision the demands of occlusions, relations and articulation. Generally speaking, the paper is purely technical as must be expected in analyzing and interpreting the complex problem of articulation and occlusion, which in itself is purely mechanical. To my knowledge, this paper can truly be classed as original, the outstanding points being the enumeration of the laws of articulation, the chart analyzing articulation and the articulation quint, the latter enabling the general practitioner to read and apply the laws of articulation appertaining to the five main factors without expecting him to be a highly trained technical expert. This articulation quint is an invaluable contribution toward the comprehension of the laws of articulation. Your attention is also called to the table giving the malassociations of occlusions and relation when "missing the bite." This table presents the basis for the possibilities of correcting trauma and errors. May I offer a résumé of what to me seem the high spots in this essay: 1. Denture work as practiced by the majority of our profession is woefully in want of improvement. 2. Mouth conditions the result of natural, accidental or habitual causes being very difficult to treat are seriously aggravated and made much harder to care for by slipshod practices. 3. To stem the tide of the increasing problems that are daily confronting us, we must devote a great deal of our time and energy as individual practitioners to the study of occlusions and their association with jaw relations and articulation, as well as to the kindred subjects pertaining to denture prosthesis. 4. We should familiarize ourselves with the laws of articulation as presented by Mr. Hanau and make a practical application of them daily in our denture work. 5. Finally, we should wake up to the fact that, in the field of scientific endeavor, there is no place for the injection of personalities, pleasant or otherwise. Science is based upon true statements of facts and needs no other supports. Truth must conquer.

C. J. R. Engstrom, Los Angeles, Calif.†: As much of this valuable and important paper is peculiarly technical, I give you my interpretation of a few of the points made. Owing to the lack of scientific training, the average dentist is inclined to accept the mystic and follow the line of least resistance in trying to solve his many problems. He has been waiting for the standardization of the human being and the automatic device to cure the ills *genus homo* is heir to. A perusal of some of the literature outside that pertaining to dentistry will be helpful to the realization that fundamental laws must be obeyed in all successful procedures. Articulation can only be simplified by comprehending the laws that govern it. These laws are now compiled for those who desire to apply them. It is true that for thousands of years the crooked stick and man power was the means for cultivating the soil. We now have tractors and gang plows but many individuals still use the crooked stick. The teeth and supporting tissues have several functions, that of mastication being most important. The efficiency of mastication is in direct ratio to the coordination of all factors involved; hence, changing one factor modifies the efficiency.

While it is true that some of these factors are beyond our control (as we are dealing with human beings) that is no reason for not knowing their relative value and counteracting any undesirable effect they would have. Too much energy is wasted trying to fit the patient to the creations of the dentist. If we study without bias what has been presented today, we shall find much of the mystery has vanished. We shall probably understand why we made such a grand success of Mrs. Smith's case and failed on Mr. Smith and all the Jones family.

A. A. Nelson, Detroit, Mich.: It was my pleasure to learn this summer that Dr. Alfred Gysi of Zurich, Switzerland, was in this country, and I immediately got in touch with and invited him to come to this meeting and make a presentation, or at least send us a paper to be read before the section. Dr. Gysi wired me that, as he was sailing immediately for Europe, he could not be present at the

†Read by F. M. Hight, Houston, Texas.

meeting, but he would be glad to discuss one of the papers. I left the selection of the paper he wished to discuss to him, and he chose Mr. Hanau's presentation. I am going to ask Dr. Russell W. Tench, who was personally associated with Dr. Gysi, to read his discussion of Hanau's paper.

Alfred Gysi, Zurich, Switzerland†: I have read the paper that R. Hanau is going to read at your meeting at Louisville, and have found that the conclusions he has arrived at coincide very closely with those of my own personal investigations and those of my associates, at the Dental College at Zurich, Switzerland. Hanau and my school have worked independently of each other, and it should not be a surprise that similar thoughts are expressed in different terms. Only the careless reader may conclude that our findings differ in principles. I can assure you that while reading Hanau's paper and analyzing it, I could find nothing that I would not approve of at present. In many points, Hanau has arrived at advanced results which to me appear quite logical. I expect that, on closer investigation and checking, we, in Zurich, shall be able to confirm his findings. Some of my personal work, still in the hands of the publishers, and the recent investigations by my associates, will soon be published. Both will prove what I have just said. Our understanding of the problem of articulation now is such that the dental profession can safely accept it, and by so doing, may obtain marvelous results. Of course, we should not dream of a panacea for all prosthetic ills; yet it may be assumed that, in the present status of prosthetic knowledge, the dentist should be able to render better and safer service to a denture patient than a physician ordinarily can to a patient suffering a systematic disturbance. Unhappily, the contrary is the case as regards the prosthetic services rendered by the large majority of dentists. I sincerely hope that the National Society of Denture Prosthesis will assume the leadership in advocating modern prosthetic methods and contribute to the understanding and proper application to such an extent that even the nonspecialists can take them up and find that, in the end, good scientific work is more profitable than the use of most of the present unscientific methods. As in other lines of human endeavor, many false prophets have cropped up and will crop up, adding confusion among us. As a group of earnest workers, we should already have arrived at an understanding of the fundamental principles of articulation and their application, if the hindrances of all kinds had not been so great.

J. W. Needles, Kansas City, Mo.: Mr. Hanau's paper is entirely too long, unnecessarily abstruse and complicated. Almost every phase touched in the paper is defined both in the positive and then in the negative, which is unnecessary and unscientific. The next criticism I have is that Mr. Hanau has attempted to relate many conditions which are almost unrelated. This complicates the paper to such an extent that it is almost incomprehensible to the average mind. There are many good features in the paper and many truths are expressed but they could be made much more useful by leaving out the superfluous and simplifying the rest.

F. W. Frahm, Los Angeles, Calif.: The definitions of new terms should be carefully studied and considered by a number of qualified men before we can consider them worthwhile and acceptable to the profession or the teaching staff of our colleges. Articulation is not a mythical thing, but a real every day problem. I want to commend Mr. Hanau on the whole paper in the abstract, because it has real merit. The more we study this paper the better we will see the results as a whole, and the more light we will have on some of our problems. The surgeon who is not willing to get down to the base of the trouble, locate the causes and eliminate errors will never get anywhere. Neither should the dentist expect to obtain results from inaccurate and slipshod methods. I would urge every man to read and reread and study Hanau's paper and make it a part of his practice.

†Read by Russell W. Tench, New York City.

RADIOGRAPHY AND DIAGNOSIS*

By GEORGE R. WARNER, M.D., D.D.S., Denver, Colorado

IN the history of dentistry, which dates back thirty-five centuries before the Christian era, we find records of the empiric treatment of dental ills. The sacerdotal physician-dentist used drugs internally and externally, blood-letting, charms, incantations, and what not, without much, if any, idea of cause and effect.[1] This primitive dentistry obtained until the sixteenth century, with few notable changes or improvements.[2] Even though this and the two following centuries were epoch making in dentistry, the tendency to empiricism was still most marked. Indeed, it is not far fetched to say that the dental profession, as well as the medical profession, is not yet well out of the period of empiric practice.

Diagnosis has not, until recently, been given a place in the curriculums of our dental colleges; therefore, the young dentist has hardly known what a diagnosis was. He has had to evolve a plan of examination and diagnosis as he has gained experience through practice and increased his knowledge through study and practice.

That an adequate diagnosis is the right basis for the treatment of each and every case presented to us, all agree.[3]

With the advent of the roentgen ray and the pronouncement of the theory of focal infection, the dental profession has had the opportunity to assume its rightful position and accept its undoubted responsibilities in relation to the health, happiness and very life of the man, woman or child entrusted to its care. We are demanding that position and accepting that responsibility, only as far as we are keeping up with the advance of our science and applying our knowledge to every case that comes under our care.

It is not my thought to impose on every dentist the burden of a complete general physical examination for each patient who seeks his professional services. Such an examination is neither necessary nor desirable in every instance. Neither is it necessary for a dentist in general practice to make a complete dental examination for every patient. By a complete dental examination, I mean an examination upon which might be based a diagnosis for orthodontia, periodontoclasia, prosthodontia or any of the other special fields of endeavor into which the practice of dentistry has become divided.

*Read before the Section on Operative Dentistry, Materia Medica and Therapeutics at the Sixty-Seventh Annual Session of the American Dental Association, Louisville, Ky., Sept. 24, 1925.

1. Guerini: History of Dentistry, p. 21.
2. Guerini: History of Dentistry, p. 161.
3. Best, E. S., and Waldron, C. W.: J. Dent. Res. 3 (Sept.) 1921.

It is desirable, in most instances, to make an examination upon which can be based a diagnosis that will make it possible to inform the patient with some degree of accuracy as to the probable relationship of his oral cavity to his general health, and the operations necessary to make his oral cavity a negative factor in systemic disease, and the best possible positive factor for good health.

Such an examination must not be so long, involved or tiresome that it will be dreaded by the operator. If the plan of examination will not lend itself to reasonably easy execution, we may rest assured that the plan will not be followed.

One of the fraternities of our city worked out an examination chart a few years ago that was detailed to the last degree. It was a wonderfully comprehensive and accurate chart, pronounced by all the members of the fraternity to be ideal. Enough charts were printed to give each member a liberal supply. All started out enthusiastically to use them, but I doubt that a single one is being used at the present time. They were so complicated and tedious that they killed enthusiasm almost at once.

If it is desired to make a comprehensive examination, one may follow the details presented in the accompanying table; and we frequently have cases in which as extended an examination as this should be made.

In any event, an examination should be prefaced with, or have as a part of the routine, a short history. Our final determinations will be or should be influenced by the patient's general condition, present and past, as well as the family history. Heredity is recognized as a potent influence on the prognosis of any given case.[4] This history having been secured, what are the principal conditions in the mouth that should be noted and recorded in order that we may be able to inform the patient with some degree of accuracy as to the probable relationship of the condition of the oral cavity to his general health, and the operations necessary to make the oral cavity a negative factor in systemic disease and the best possible positive factor for good health? Let us now systematically list these conditions. We may very properly first consider the external surfaces of the oral cavity. The submaxillary glands and the glands of the neck should be digitally examined, and the contour of the face and neck noted before examining the intraoral surfaces.

If there is a question of focal infection, we should look at the throat and inquire as to possible septic involvement of the tonsils. The paranasal sinuses should also be considered as possible sources of infection and their condition ascertained by radiography and conference with the otolaryngologist.[5]

In the intraoral examination, the first thing to be gone into should be the condition of the soft tissues, those covering the alveolar ridges and their reflections to the cheeks, lips, palate and floor of the mouth. We should look for tumors, fistulas, leukoplakia and areas of hypertrophy and observe the condition of the marginal gingiva,

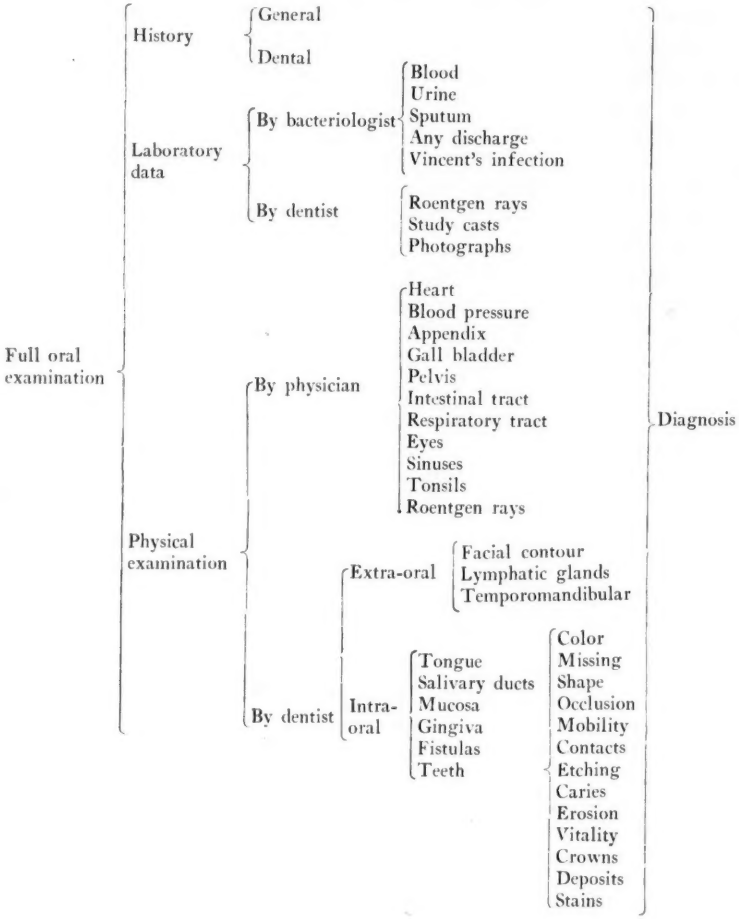
4. Price, W. A.: Fundamentals Suggested by Recent Researches for Diagnosis, Prognosis and Treatment of Dental Focal Infections, J.A.D.A., 12: 641 (June) 1925.

5. Mayo, C. H.: J.A.D.A., 12 (Aug.) 1925.

pressing the gums to determine whether pus is present.[6]

After making this much of a survey, findings should be recorded so that they admit of easy and quick interpretation. This necessitates having a chart that is

COMPREHENSIVE EXAMINATION CHART



we are ready to examine the teeth. The examination of the teeth should be systematic in every case, and the simple and uncomplicated and at the same time comprehensive enough that at least the salient points in the average case may be recorded in such a manner that a picture of the case is

6. Lyons, C. J.: J.A.D.A., 12 (May) 1925.

presented to the eye at any subsequent examination of the chart.

I present herewith the chart that I use. (Fig. 1.) The buccal, labial, lingual, occlusal and incisal surfaces of the teeth are shown. The deciduous set of teeth is not shown. This is not because of any lack of appreciation of the necessity of the same meticulous care in examining the teeth of children, but because of the difficulty of finding space for an extra chart and because of the ease in adapting this chart to children's needs. When the chart is used for a child, the bicuspids are marked with a *T* and cavities in the temporary molars marked thereon.

The teeth are separated by lines so that each tooth is in a box by itself. This is in the interest of clarity, that notations in regard to the character of restorations to be made or fees to be charged therefor will surely be ascribed to the tooth for which they were intended. As soon as an operation is completed, it may be checked on the chart; which will relieve the operator of the necessity of examining the mouth

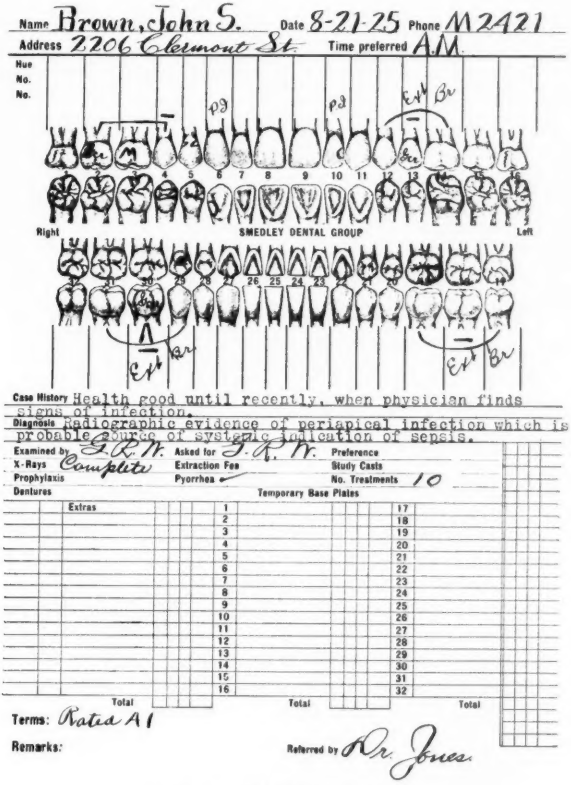


Fig. 1.—Examination chart.

at a subsequent sitting to ascertain what has been done previously and what should or can best be done at this sitting.

It is my experience that the majority of people like to have some idea as to the probable cost of contemplated work. This lower part of the chart is for the convenience of the operator in totaling the items. It also enables the patient to see this procedure carried out. If the patient has no idea of the value of the services, he may be shocked at the mention of the total fee. But

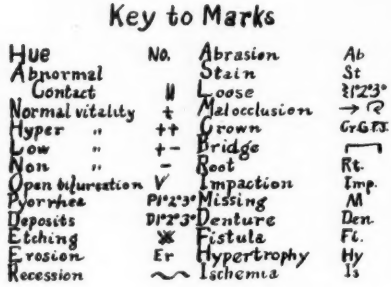


Fig. 2.—Key to marks used on chart (Fig. 1).

if he sees the fee for the operation on each tooth put down, first, opposite the tooth, and then brought down to the column below and the different items totaled, his mind goes through the same processes that ours has gone through. This usually results in his being so well prepared for the total, when it is finally reached, that it does not seem nearly so large as it would have seemed if the total had been given without the preliminary steps.

Why do I go into this financial phase of examination and diagnosis? Or, why is the matter of fees a part of examination and diagnosis? For the reason that examination and diagnosis is only a preliminary step to treatment. Of what benefit is a careful and thorough examination if the treatment indicated cannot be carried out in the most desirable manner because the patient isn't convinced of the value of the suggested services or the fairness of the fees? We will have to admit that such an examination and diagnosis is of only academic interest, if the treatment indicated is not to be carried out. Therefore, any method or procedure that will tend to convince the patient as to the desirability of the operation or restorations that are indicated by, and advised because of, the examination and diagnosis, and as to the justice of the proposed fee, is an integral and important part of that examination and diagnosis.

As to the further details of the examination and the order in which they are carried out: This order is based upon psychology, the idea being to make the examination in the inverse order of its liability to cause apprehension, discomfort or pain. Therefore, the external examination is made first, as noted above, with observations of the soft tissues of the interior of the mouth, sketching the position of the border of the marginal gingiva on the chart as shown here, with irritation or hypertrophy indicated. Next, the missing or unerupted teeth can be noted, as well as peculiarities of structure or position. Please note the word "position," because a tooth out of its normal position is a potential source of serious systemic disturbance, through the sympathetic nervous system, if not directly. We may next make a notation of the mobility of the teeth, arbitrarily dividing the amount or extent of the mobility into three degrees. The amount of mobility cannot be a fixed factor as to the salvability of a tooth. The degree of mobility will have to be related to the

shape, length and number of roots and the position in the arch, and further depends on whether it is in the maxilla

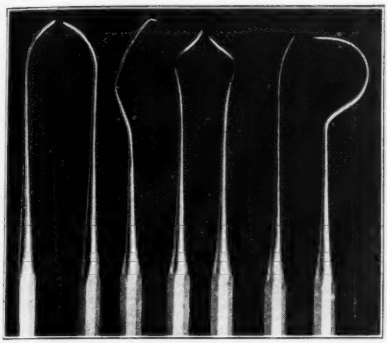


Fig. 3.—A workable set of explorers.

or mandible. For instance, mandibular incisors are often salvable when exhibiting the third degree of mobility; whereas, the same degree of mobility in a maxillary incisor would almost invariably indicate that it was not salvable.

The bifurcations should then be explored for openings, and, if open, marked with a *V* at the bifurcation on maxillary molars and an inverted *V* on mandibular molars.[7]

psychic effect of electricity, it is my preference to use ice for this purpose. A slender pointed piece of ice wrapped in a small mouth napkin is a most convenient means of making this test. Gold shell crowned vital teeth will usually respond to the ice; whereas, electricity cannot be used for this purpose. Electricity can be used on doubtful teeth, and it will frequently elicit a positive response where ice fails to do so. It is not uncommon for teeth that fail to react to either ice or electricity, to respond quite definitely to the bur. So the bur is the last resort in testing for vitality. It is sometimes necessary to remove shell crowns for final determination of vitality.

The response to thermal shock is relative. Many people can hardly tell the difference between their vital and pulpless teeth when either ice or electricity is used in making the test. The matter of hypersensitive and hyposensitive teeth is of grave importance and should be given thoughtful consideration. Teeth with deep caries, which are either hypersensitive or hyposensitive, are potential sources of infection.[8]

Transillumination is advocated as an

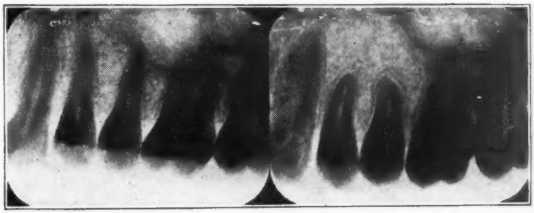


Fig. 4.—Films showing concealed cavity.

The teeth should now be tested for vitality. Because of the unfavorable

essential in diagnosis, and although I have used it for three years in a major-

7. Simonton, F. V.: J.A.D.A., 12 (March) 1925.

8. Henrici, A. F., and Hartzell, T. B.: Cosmos, 53: 91 (Jan.) 1921.

ity of examinations, I am not thoroughly convinced of its place as a diagnostic aid. Its use in detecting

Fig. 5.—Films showing decay under filling. Left, before, and right, after aspirating.

inflammation in the pneumatic cavities adjacent to the mouth is of long standing and of undoubted value. Its place as a determining factor in the retention or loss of pulpless teeth is not so well established, as far as my experience goes.

In this procedure of examination and

Fig. 6.—Film showing decay under filling in second bicuspid.

diagnosis that we are considering, I have left the examination for caries until the last. This is not because I think it of the least importance but because we wish to impress on the patient the fact that it is not of the greatest importance and of course is, in some instances, of relatively slight importance. This is more especially true in later life. Moreover, if the patient has very sensitive teeth and has, perchance, what we might call a dental complex, we do not wish to use instruments in the mouth until we have gained his confidence and somewhat allayed his fears by making the major portion of the examination without the use of explorers.

Even in the examination for caries, the use of explorers should be limited to actual necessity. When explorers are used, they should be extremely sharp.[9] A sharp explorer will detect a small opening through the enamel without much pressure. Another rea-

9. Bödecker, C. F.: Microscopical Study of Enamel Fissures with Reference to Their Operative Treatment, Cosmos, *66*: (Oct.) 1924.

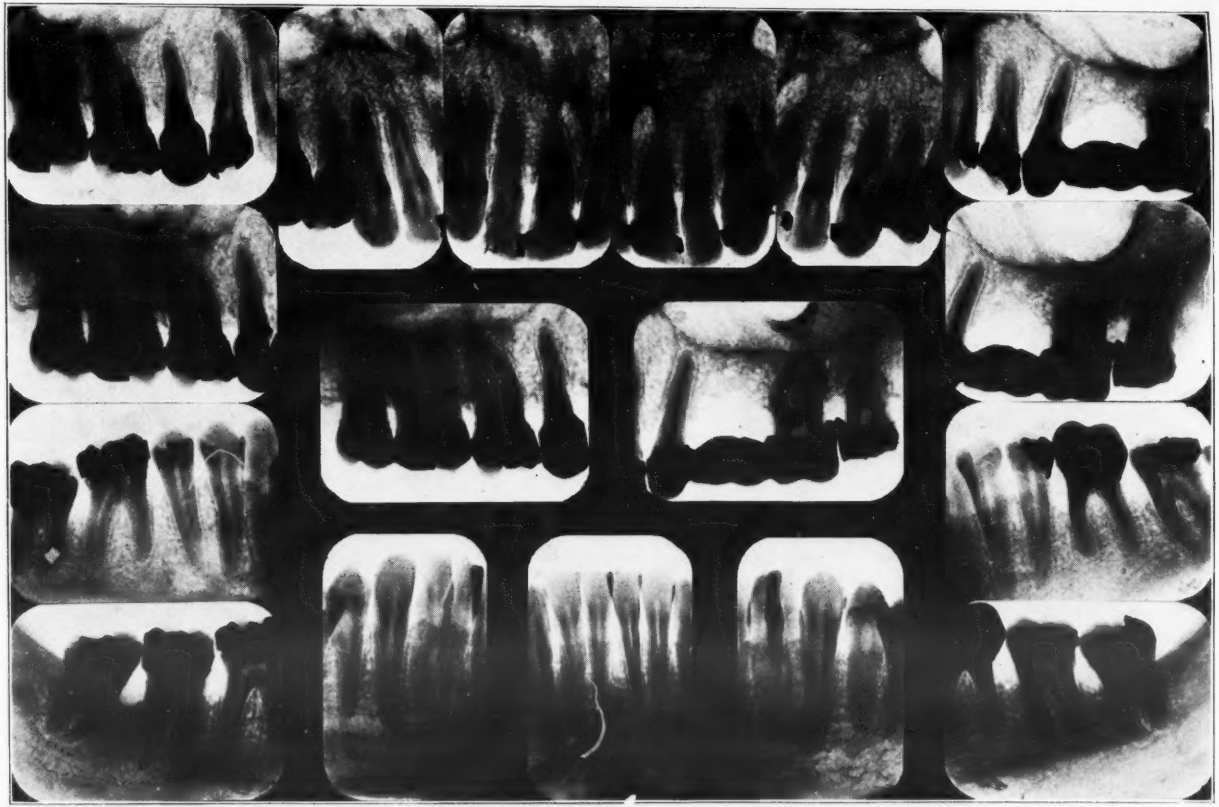


Fig. 7.—Films of case recorded on chart shown in Figure 1.

Fig. 8.—Films showing high calcium content of alveolar bone.

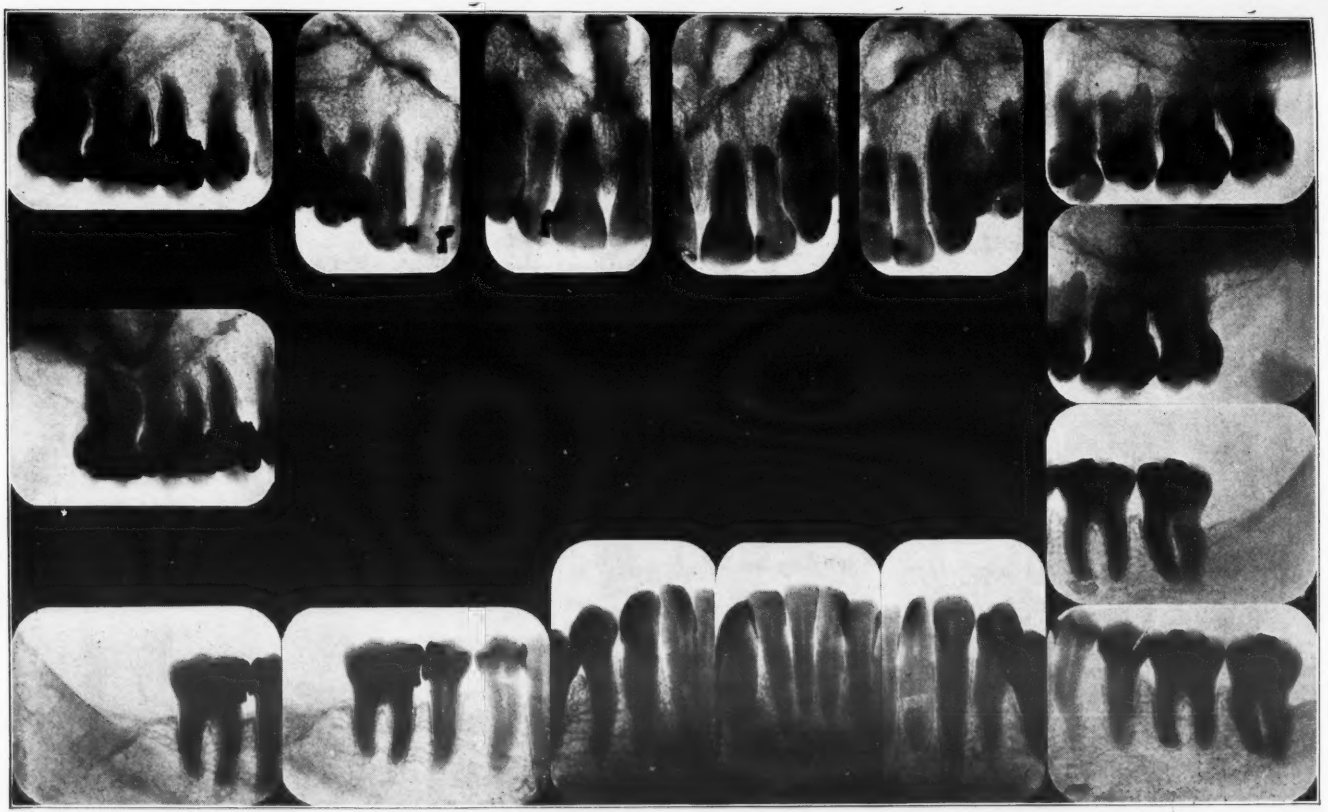


Fig. 9.—Films showing low calcium content of alveolar bone. These films and those shown in Figure 8 are from patients, husband and wife, living presumably on the same diet.

son for using sharp explorers is the physical fact that caries can be quite extensive in the dentin and yet have a most minute opening through the enamel. Therefore, every pit should be carefully tested with a sharp explorer, and also the contact areas, as far as can be reached with explorers. (Fig. 3.) Undermining of the marginal ridge by caries can usually be detected by the appearance of the ridge. An opaque, light or dark appearance of the enamel is indicative of a change in the underlying structures, which is usually proof of a carious process.

In deciding as to whether small pits should be opened and filled, consideration should be given to the type and age of the individual and the type of the teeth.

It is much better to open a pit or contact area occasionally which is not decayed than to allow caries to invade the pulpal area because of overcautiousness in opening into doubtful spots. It is my experience that infinitely greater harm has been done by overlooking caries than by being too radical about cutting into suspicious areas. (Fig. 4.)

The examination of filled teeth is fraught with many difficulties, and, until the advent of the roentgen ray, was most unsatisfactory and uncertain. But the accessible margins of fillings should be gone over carefully with explorers; and discolorations around fillings should be looked on with much suspicion. (Figs. 5 and 6.)

After the physical examination of the mouth is completed, radiograms should be made of every area.[10] Fourteen films are the absolute minimum properly to diagnose the conditions in any mouth; and frequently, twenty or more are necessary.[11] (Fig. 7.)

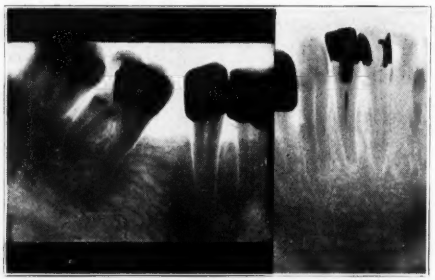


Fig. 10.—Pathologic conditions of bone in periapical areas.

While it is not proper or possible to go into the technic of radigraphy in this paper, I believe it is pertinent to say that radiograms, to have any diagnostic value, must be clear and contrastive, without distortions as to length of teeth, plane of tissues or overlapping contact areas.

The radiograms should be carefully and systematically studied. The mouth should first be examined for general density or calcium content. Fine trabeculae and small intratrabecular spaces giving the general effect of radio-

10. Hartzell, T. B.: Cosmos, 64 (April) 1922.

11. Pollia, J. A.: J. Dent. Res., 5 (March) 1923.

pacity are indicative of high calcium content; whereas, coarse trabeculae and large intratrabecular spaces, giving the general effect of radiolucency, are

Fig. 11.—Effects of traumatism.

indicative of low calcium content; the age of the patient being taken into consideration in each instance.[12] (Figs. 8 and 9.)

The alveolar bone should be gone over minutely for changes in structure that might be due to pathologic conditions. (Fig. 10.) The lamina dura and periodontal membrane must be examined for changes indicating irritation from chemical, bacterial or mechanical causes. (Fig. 11.) The crowns of the teeth will bear the most careful inspection for caries, in either unoperated areas or under fillings or crowns. (Fig. 12.) The roots should be critically examined for destructive or constructive changes. (Fig. 13.) The pulp chamber and canals should also be considered as to calcic degeneration of the contents and filling in of the lumen. (Fig. 14.) All restorative work should also be critically examined in the radiograms.

Much more might be said in regard to the interpretation of radiograms, if time permitted. There should be no restriction of time in examination of radiograms. The more time devoted to this purpose, the richer the rewards in accuracy of diagnosis.

Study models should be made for those cases that involve the replacement of teeth, the raising of the bite or the adjustment of marked traumatic occlusion. The many problems of balancing the occlusion so that restorations will be efficient and pleasing to the pa-

Fig. 12.—Cavities under fillings and in areas in which no operative work was done.

12. Pollia, J. A.: J.A.D.A., 9 (Jan.) 1922.

tient and acceptable to the periodontium can be studied more satisfactorily on good plaster models than in the mouth.

Full face and profile photographs are also a great aid in making a diagnosis in a case involving extensive restorations.

After securing all the data hereinbefore detailed or whatever part of it the case demands, the patient should be dismissed with an appointment for a subsequent sitting.

At the subsequent sitting, more radiograms may be made or the previous

Fig. 13.—Destruction of roots and hypercementosis.

examinations may be amplified in any manner or to any extent that the previous findings, subsequent developments or the patient's wishes may demand.

We will then be in a position to make a diagnosis that will be of real and lasting value to the patient and will make the execution of the necessary restorations both pleasant and satisfactory to the operator.

DISCUSSION

James A. Blue, Birmingham, Ala.: It has been pointed out that examinations and examination charts to be effective and not defeat the purpose for which they are intended should be simple and comprehensive but at the same time so arranged that the desired information can be compiled. It is necessary for the dentist and physician to work together for the common good of the patient and, as the public recognizes more and more the importance of good dentistry and the value of the dentist's opinion regarding oral conditions, the easier this cooperative work between dentist, physician and patient will become. If the dental examination is made by a dental diagnostician, it should be in such comprehensive form that it will be of real value to the dentist who is to make the restorations. The condition of the tonsils should always be taken into consideration as a causative factor of neurotic pains in the jaws, neck, ears and eyes as well as general

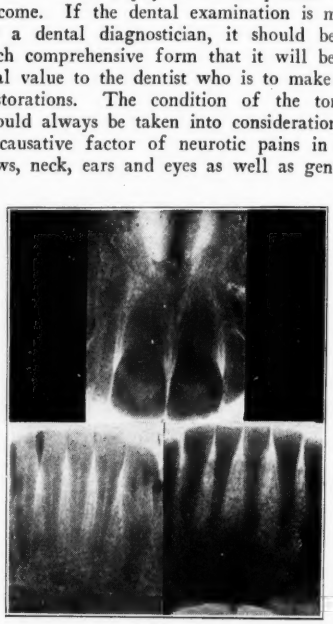


Fig. 14.—Films showing obliteration of canals.

systemic manifestations. One of the greatest blessings the roentgen ray has in store for present and future dentistry is its ability to reveal decalcification of the proximal enamel and cavities under the free margins of the gums. Here it is most needed. There has been much written in the past year pro and con regarding this subject. Many of us have for years been noting proximal cavities as revealed on the film, but until Dr. Raper came forward with his interproximal examinations, little, if anything, had been written on the subject and to him goes the credit for drawing attention to this method. While I am not following his technic to any great extent, I am employing a technic that reveals the apices as well as the interproximal surfaces; but I see no reason why Dr. Raper's method should not be extensively used by the

general practitioner of dentistry. The frequency of such examination depends largely on local conditions. If the teeth are soft and prone to decay they should, of course, be more frequently examined radiographically than teeth that are hard and resistant. There was a time when fees were never mentioned at professional gatherings of this kind, but it is now considered a part of a dentist's professional duty to his patient as well as a protection to himself and family to let each patient know as nearly as possible what fees he will be called on to pay.

Harry M. McFarland, Kansas City, Kan.: Dr. Warner's paper forms the basis for future work. It is the foundation upon which all future plans must be built. This is an especially important subject since the establishment of the facts pertaining to the relation of focal infection to systemic disease. Dr. Warner has emphasized the fact that, in many cases, the dental profession is responsible for the health, happiness and in many instances the lives of those entrusted to our care. We should make a sufficient examination, as has been suggested, and, after the desired information is secured, the patient should be informed as to the condition present. Many times, there are influences that tend to keep the facts from the patient. If we do not inform them of the existing conditions, they will consult someone who will. It is our duty to explain the result of the diagnosis and advise as to what we think best. Then it is the patient's responsibility to do as he prefers. He takes the responsibility and, if something develops, we cannot be held responsible. The chart suggested includes many of the essentials in the foundation of a proper diagnosis. No suggestion has been made as to transillumination. There are many cases in which it would seem that a diagnosis would not be complete without the information secured by the infra-orbital and the intra-oral transillumination. We are able to determine pathologic conditions in the antrum by the use of the antral light. Transillumination may be a means of verification of other things that are doubtful. It may show darkness of buccal process, stasis or organic discoloration that may not be discovered by the roentgen ray or the vitality test. Fees are better understood and more easily collected if definitely arranged before operation. A fee should be charged for a thorough examination and diagnosis commensurate with the time and ability required for the procedure. Many cases are given little attention for the reason that a just fee is not paid for the examination. Suggestions have been made as to securing plaster models when restorations are to be made. It is much better to take a modeling compound impression of the teeth before they are removed and place the teeth in the impression, then build models upon which are the natural teeth for study and guide in reproduction. Dr. Warner has mentioned the necessity of making radiograms of every area. I agree that fourteen films are the absolute minimum properly to diagnose the condition of any mouth. Sixteen are better. Also let me emphasize the need for concerted effort to produce good radiograms. Often, radiograms are used that have very little diagnostic value. It is important to assist in the interpretation of the radiograms by the vitality test. Dr. Warner's suggestions follow out the idea that the most important thing in dentistry today is preventive dentistry. We must put forth every effort to avoid the complications with which we have to contend. Prevention is better than correction. How much better it would be if there were no pulpless teeth, if there were no foci of infection, if there were no systemic disturbances and complications. What a blessing it would be if it were possible to maintain a physiologic condition. Every effort should be put forth to prevent the conditions that make such exhaustive examinations necessary. Let us strive to reach the goal and, by so doing, we will increase the efficiency of our service.

CYSTS OF THE JAW*

By R. A. FENTON, D.D.S., Iowa City, Iowa

THE object of this paper will be to discuss briefly the classification of cysts, their etiology, microscopic pathology and symptoms.

In more detail, I shall discuss their relationship to surrounding tissues, the important factors determining the diagnosis, and the essentials of scientific treatment.

I would bring to you the fact that it is not well to consider all cysts simple affairs, while admitting that many require simple operative procedures. A few may be extremely difficult to remove and almost defy complete removal without resection of the mandible.

Protect yourselves on diagnosis and prognosis and you will sometimes save considerable postoperative explanation when you discover that the cyst has recurred, or that you fail on the diagnosis and are dealing with a growth in place of a cyst.

The operative procedure is simple for most cysts, if they are of a certain type, but one failure will offset fifty successful operations, unless the operator has protected himself in diagnosis and prognosis, and has obtained all the scientific data connected with the case.

Two cases were reported to our clinic. They were both recurrences of apparently multiocular cysts or adamantinomas. Operation had been performed two to three years previously. One came in with a former diagnosis of adamantinoma. The tissue had been sectioned and diagnosed as such by a competent pathologist. In the second case, no tissue had been saved and no microscopic diagnosis made; hence, there was no aid in making the present diagnosis. The history is a very important factor to the pathologist as well as to the clinician.

The roentgen-ray appearance of both cases was very similar. The location of the lesions was similar. The gross findings at the operation were similar, yet the second case turned out to be osteitis fibrosis cystica (no epithelial tissue), while the first case was an adamantinoma. Was the second case a cyst, an admantinoma or osteitis fibrosis cystica, three years ago? Those data would have been very valuable to operator and pathologist at the present time as to both diagnosis and prognosis.

Both operators failed, as perhaps I have. Time alone will tell; but one operator failed scientifically, while the other could just as well have operated before the days of microscope and pathologists.

Don't misunderstand me. I would not have laboratory tests and findings displace history and clinical findings, for I know that, as yet, there has been no laboratory test to take the place of

*Read before the American Society of Oral Surgeons and Exodontists, Louisville, Ky., Sept. 18 and 19, 1925.

common sense. Yet, I do believe we should take advantage of all modern facilities in aiding us to a right diagnosis and prognosis. And even then we will sometimes make mistakes, but perhaps we can reduce the percentage of our mistakes.

You may have no pathologist where you are practicing, but that is no alibi, as tissues can be preserved in a solution of formaldehyd and a portion can be sent to a pathologist.

Do not think I am a Pharasee or that I am high hatting you: I have probably had more grief than any of you because I have had the opportunity for much grief and I am giving you the benefit of my experience during the past ten years in hopes that you may avoid a few rough spots. If you become too positive in statements to your patients, too sure of your knowledge, you are riding for a fall. Always leave some leeway. Alexander Pope says "The mouse that trusts himself to one poor hole is not a mouse of any soul."

Neither would I have you vacillate and lose the confidence of your patients. Only don't promise too much or assure the patient that he has just arrived at your office in time. It is hardly necessary to be so scientific or pseudo-scientific as to deal with contaminated cultures or to show a cloudy test tube to the patient in twenty-four hours to demonstrate that the teeth you extracted were badly infected.

That is straight commercialism and better appreciated in the clothing business than in a profession for service to the people.

In our clinic, we observed a case which, at first thought, seemed a simple dentigerous cyst, but which, on further investigation, proved a dentigerous cyst plus a giant cell tumor.

Another case that history and roentgen ray would lead one to believe was a root cyst or an inflammatory cyst further investigation proved to be a giant celled tumor. A third case, that by history, location and roentgen ray and by the nature of the material removed at operation seemed to be an adamantinoma or the third type of cyst, was osteitis fibrosa cystica. A solid type of adamantinoma that gave the clinical appearance of a carcinoma by the microscope was diagnosed as an adamantinoma.

Thus you see why I wish to stress complete examination. And while Caesar, in his Commentaries, says that men think largely what they wish to think, it is well to pick up all the data before thinking out loud to the patient.

As to classification of cysts, the simplest classification suits me best, as that comes within my understanding. This classification is according to origin. The root cyst springs from epithelial cell rests in the peridental membrane. Three forms of cysts or tumors are recognized as coming from the enamel-forming organ: (1) the dentigerous or follicular cyst, and (2) the adamantinoma or multiocular cyst; and (3) the adamantinoma may produce enamel or convert adjoining fibroblasts into odontoblasts, which, in turn, will produce an adamantinoma. This classification is by Mallory.

The root or inflammatory cyst springs from granulomas at the root ends of devitalized teeth or teeth containing dead pulps, the center of the granuloma breaking down and becoming liquified and the cavity in the bone occupied, being lined by epithelium laid down on

fibrous tissue. As to the origin of the epithelium, it is generally supposed to come from epithelial cell rests in the peridental membrane.

The sequence of events in a root cyst is, then, (1) irritation from a devitalized tooth or dead pulp; (2) granulomatous liquefication of the center and (3) the formation of the cyst.

Cysts usually grow in the direction from which they meet the least resistance, and as they grow and exert pressure on the bone, there is destruction of bone next the cyst wall, by the osteoclasts and, on the side of the bone furthest from the cyst wall, a laying down of new bone by the osteoblasts. This is truly new bone that is formed as proved by Dr. Prentis and me, and not merely a calcification, as is sometimes supposed.

The cyst fluid is usually straw colored, sometimes darker, and often contains cholesterin crystals and old epithelial cells. This fluid is sometimes gelatinous. Infrequently, this fluid may contain bacteria, either because the cyst has ruptured into the mouth or been contaminated by surgical procedure, or possibly of hematogenous origin.

The cyst wall consists of fibrous tissue lined with epithelium, the thickness of this wall depending somewhat on whether the cyst communicates with the mouth or nose and the length of time this communication has been in effect.

As to symptoms, these cysts develop slowly. In these early stages they usually produce no symptoms, unless they become infected, and usually are discovered only by roentgen ray. Later, the symptoms that arise will depend on the structures involved, and on pain when nerve trunks are involved. Changes in contour of the jaws or face, or both, and all the symptoms of an acute inflammation are present if the contents become infected.

Often, palpation gives the impression as of feeling parchment, almost a sensation of crepitus, but not always, depending on the thickness of bone over the area palpated.

An important symptom is the obtaining of cyst fluid by aspiration and its examination. This more than any other thing will protect you from a surprise party at operation.

The roentgen ray will show a definitely outlined cavity. On these symptoms, plus history, we make our diagnosis, and then, if puzzled at all by our findings at operation, we turn the material over to the pathologist.

Cysts must be differentiated from empyema of the antrum, hydrops of the antrum, and growths, more frequently some type of sarcoma than carcinoma, owing to the fact that cysts usually develop earlier than the carcinoma age.

In regard to the relationships to surrounding structures: nerve trunks and blood vessels are not destroyed by the cysts but are gradually pushed to one side until they may occupy abnormal positions. The antrum is, in some cases, practically eliminated by the cyst pressing the antrum floor up almost to the orbital plate. The true antrum remains much reduced in size but not involved.

REPORT OF CASE

A man, aged 33, had a discharge of very foul pus at night, from the left side of the nose. This had continued for the past two years, following an acute inflammation of that portion of the face and mouth. Roentgen-ray examination of the sinus showed that the left antrum was blurred. Transillumination showed that the left antrum was dark. Puncture and washings of this region through the nose yielded a large amount of foul pus. Yet operation showed the true antrum pushed

almost to the orbit and not involved, and a large root cyst extending from the central to the second molar, occupying most of the normal antrum space. This cyst had become infected and had formed a sinus in the inferior meatus of the nose, which explained the discharge of pus. The condition simulated empyema of the antrum.

It has been my observation that, while realizing that it is clearly possible for an antrum to become infected from an acutely infected cyst breaking into it, by far the most frequent cause of antrum involvement is the strong arm of the operator when removing the cyst, as often the cyst wall and antrum mucosa are almost in contact and this requires extreme care in removing the cyst wall and not tearing out the floor of the antrum.

Treatment.—There are various methods of treating these cysts, all of which are surgical. The size and location may influence the detail of treatment. The route of approach should practically always be from the buccal or labial side. It would especially condemn the opening of these cysts through the roof of the mouth as deformity there is not well tolerated. It may interfere with speech and also require the wearing of a plate.

The method most successful in our hands consists of the elevation of the soft tissue on the labial or buccal side, starting at either the gingiva or an incision higher up. The removal of the labial or buccal plate, and the complete enucleation of the sac in its entirety, followed, if there is any question about the complete removal of the sac, by the application of phenol, later neutralized with alcohol. Then the bony margins are so beveled as to allow partial collapse of the soft tissues. The cavity is then packed with gauze moistened with quaiacol and olive oil. Packs are changed every twenty-four hours, and gradually reduced in size, and, after the first two or three days, plain gauze or iodoform gauze is used. The first pack may be placed in tightly so as to arrest possible hemorrhage. Future packs should be placed in the cavity lightly so as to stimulate rather than hinder the formation of granulation tissue.

If the surface becomes epithelized over, and there is still much deformity, the epithelium is removed by chemical cautery and granulation again stimulated.

In our observation, we find much more regeneration of bone in the mandible than in the maxillae. While deformity can be largely eliminated in the maxillae as well as the mandible, the material which eliminates it in the maxillae seems to be soft tissue to a greater degree than bone. Hence, without history and clinical findings, the roentgen ray alone might make a postoperative case appear as a preoperative case. Another method of operation is the Partsch, which consists of removing the buccal or labial soft and hard tissue overlying the cyst, and also the buccal or labial portion of the cyst wall. The operation is then completed by suturing the margin of the remaining sac to the mucoperiosteum. Recovery is rapid as there is merely a suture line to heal. The epithelial lining of that portion of sac left in the cavity undergoes a change so that it simulates the epithelial lining of the mouth.

The objection to this form of operation is that the deformity, being lined with epithelial tissue, remains to a large degree still a deformity.

A third form of operation as described by Berger consists of the

enucleation of the sac, followed by the suturing of the mucoperiosteum back to the original position, either leaving the cavity filled with blood or a pack which can be removed at a point where a suture is omitted.

The success of this operation would depend somewhat on the size of the cyst and hence the size of the blood clot, as a large clot would disintegrate long before granulation takes place. Or if a pack is used, in working through a small opening, there would be some cases in which the cavity would become epithelized and a second cyst would be formed.

After asking some of the best oral surgeons in this country relative to this form of treatment, I found it condemned in cases of large cysts by all except one man, who admitted that, sometimes, it might result in a cure. This entire discussion has been given to root cysts; but what applies to root cysts will also apply to dentigerous or follicular cysts, except as to origin and time of origin. The dentigerous cysts develop from the enamel-forming organ of an unerupted tooth or denticle. They usually form or start to form at a time near the normal period of eruption of that tooth. Hence, they are most frequently found in youth, although we have operated on few older patients. When these later cases developed is a question.

The symptoms are practically the same as for a root cyst. The treatment is the same except, in addition to the enucleation of the sac, the unerupted tooth or denticle is removed.

One word of warning: we sometimes have a dentigerous cyst formed after the removal of an unerupted tooth without the destruction of the tooth follicle.

We sometimes have multiple cysts in the mouth, usually of the dentigerous type. These should be differentiated from a polycystitis, a rare condition effecting the long bones of the body.

Roentgen-ray examination of the long bones will aid; also, if the aspirated contents contain old epithelial cells, polycystitis can be eliminated, as these cysts of long bones are not lined with epithelium. Dentigerous cysts occur most frequently in the cuspid and third molar region.

The third class of cysts are the multiocular or adamantinomas. Their source is either the enamel-forming organ or the epithelial-cell rests in the mandible. Their location is usually at the angle of the mandible. They often involve the ramus of the jaw to the extent of the coronoid and condyloid processes. Clinically, there seem to be two types, an almost solid type and a cystic type, yet microscopically they are very much alike. They grow as branching masses of epithelial cells, some corresponding to the adamantoblasts, while others form the stellate reticulum or enamel pulp. Cysts form, owing to distension and coalescence of vacuoles lying between cells corresponding to those of the enamel pulp. Other cysts occur in the connective tissue of the stroma as a result of focal collections of fluids. This tumor or cyst usually appears in the young adults. The adamantinoma grows slowly and does not metastasize.

Its complete removal is often very difficult, and hence recurrence is not infrequent.

A number of cases are reported in

which resection of the mandible was found necessary completely to eradicate the growth.

Our experience thus far has consisted of the surgical removal of the growth, followed by actual cautery, if possible; if not, chemical cautery and then radium. My experience with radium makes me very much afraid. I know little about it, and I have seen some very bad pathologic fractures from radium burns. These growths are known by a multitude of names: adamantinoma, multilocular cyst, epithelial odontoma, cystic carcinoma, adenocarcinoma and cyst adenoma of the jaw.

Complete removal is equally difficult, regardless of the name used.

Do not be too positive regarding diagnosis until you have heard from the pathologist, as the growth may be an osteosarcoma or an osteitis fibrosa cystica, which is clinically and pathologically on the same etiologic basis as a giant-cell tumor of bone.

The third type arising from the enamel organ is the odontoma, a combination often of a cyst and a hard growth.

The enamel organ produces an adamantinoma, and this sometimes produces enamel. More often, the ameloblasts convert adjoining fibroblasts into odontoblasts, which results in the formation of dentin masses or dentin and cementum masses, or a composite odontoma may result owing to the activity of both the ameloblasts and the odontoblasts.

DISCUSSION

J. P. Henahan, Cleveland, Ohio: Simple or radicular cyst occurs very frequently and on that account is of importance. It forms as the result of degeneration of the fatty elements of a granuloma, and, in consequence, fluid is formed, the epithelial lining expands and, as it grows, it, according to Scudder, encroaches on the bone, which, because of the pressure, is absorbed. These cysts are often found to be of a large size in the anterior part of the maxilla, because the bone is not so dense as in the mandible. Because there is little or no pain, these cysts grow to great size before their existence is detected. They are often discovered by the patient because the enlargement causes deformity; at other times, because pain results from pressure, and, in other cases, because the cyst has become infected and great pain results from bacterial irritation. These cysts occur very often and attain a great size in the incisive region, especially the lateral incisor area. This is believed to be because the bone formation in that area is especially lacking in density, because of the line of union between the premaxillary and maxillary bones. The term "dentigerous cyst" is one used rather loosely. It was first used to describe a cyst developing from tooth structure, such as an unerupted tooth or an odontoma. Lately, the term has been applied to all cysts arising for any reason from or around a tooth. The "follicular cyst" is an example of this. Clinically, it resembles a "radicular cyst," but it arises from the enlarged follicle of an unerupted tooth. "Multilocular cysts" differs from "unilocular cysts" chiefly because of their line of development, which includes many cells; whereas, the "unilocular cyst" is developed in a single cell. The "multilocular cyst" is often found with a great many cells, all extremely small, giving the cyst a very irregular shape and making its eradication very difficult. The difference between a malignant growth and a benign growth very often lies in the fact that the former is not limited by a membrane. In these multilocular cysts, such as are often found in the alveolar process, especially of the maxillae, it is always wise to have a specimen examined by a pathologist. We have all seen these growths at the apical region of a tooth. After discharging its fluids, the growth lies in the cancellous tissue and it requires great perseverance to follow its crablike ramifications, without destroying more bone structure than was intended. Regarding the method of surgical treatment for these cysts, there has been considerable discussion. Lyons recommends and practices the exposure of the cyst through a window, and enucleation, followed

by surgical dressing for a sufficient time. Partsch recommends the exposure of the cyst by exposure to its extreme margins, then sectioning it there and suturing the mucous membrane. It is contended by the adherents of the method that the cyst membrane takes on the function of the mucous membrane.

Those who do not accept that theory state that the method results in the maintenance of a great fossae, as well as the retention of a pathologic membrane. I have found this membrane very thick in some cases, and while it would adapt the case to the performance of the Partsch operation, I have lacked confidence in their power of reconstruction. I have followed the Lyons method.

Frank B. Hower, Louisville, Ky.: The whole trend of our profession, and that of the medical profession today, is toward more complete diagnosis. As Dr. Fenton says, if we are slipshod or inclined toward snap diagnosis in these cases, we are only riding for a fall. This is most certainly true, not only in this particular subject that Dr. Fenton has discussed, but also in all of the phases of our work. The great majority of the recurrences in these cases are due to our failure in diagnosis rather than to the treatment of technic. I think that this is especially true in dealing with cysts, because of the fact that we know that most of these are simple affairs. Dr. Fenton tells us that we should be thorough regarding the history, clinical findings and laboratory tests of these cases. I wish especially to emphasize that we should never take too much for granted but have our diagnosis made complete by some competent pathologist. I believe that Dr. Fenton's method of treatment of complete removal, from the labial or buccal side, is by far the best. As to the use of iodoform gauze in these cavities, we should never be in too much of a hurry in dismissing these patients but should prolong treatment until these cavities have practically filled in. It has been my experience that when some of these patients are dismissed a little early, they come back with the cavities infected, and it has required a good deal of time and care to get them back to a normal condition.

J. P. Wahl, New Orleans, La.: Without a proper diagnosis, we cannot even guess at the prognosis, and we should spare no means at arriving at such a diagnosis. The operation for the eradication of most cysts might be regarded by some as a simple procedure, but we often, as you all no doubt know by experience, encounter one that gives us a great deal of trouble when we try to remove it in its entirety; and very often, after a year or two, the patient returns with a possible recurrence of the same condition, in a more aggravated form, or as a malignancy. Then we wish that we had spent more time on the case history, laboratory tests and clinical findings, which would not only have been of material importance before operating, but would be of inestimable value now. We cannot rely solely on the roentgen-ray for a diagnosis, but in most cases the roentgen ray is of great value in helping us to determine the extent of the cyst, and its possible encroachment on important anatomic parts. In Dr. Fenton's classification of cysts, the first classification, or that of root cysts, or inflammatory cysts, which spring from the granuloma at the root ends of devitalized teeth, should be of great importance to every exodontist, and should impress on every one of us the importance of a thorough curettement of the granuloma after the removal of the tooth. I have seen and removed quite a few cysts in edentulous mouths, or in places where teeth had been removed several years before, which, no doubt, had their origin in the granuloma that was left undisturbed when the tooth or teeth were removed. As Dr. Fenton says, these cysts develop very slowly and are not noticed by the patient until they either cause a slight deformity, or cause pain by involving some nerve trunk, or become infected. It is fortunate for the operator and the patient that, in the formation of these cysts, the nerve trunks and blood vessels are not destroyed, but are slowly pushed aside. I can recall a very stubborn case that came under my care a few years ago, in which the antrum was almost entirely obliterated during the development of the cyst. I heartily agree with Dr. Fenton in condemning the opening of these cysts through the roof of the mouth: they should all be operated on from the labial or buccal aspect, where an opening of sufficient size should be made to enable a complete removal of the entire sac, and a slight folding in of the tissue. Packing of the wound is essential. The third form of operation, as described by Dr. Berger, has never met with success in my hands, in cysts of any appreciable size, and I have long since discarded it. In the removal of nonerupted

not fully formed third molars, I have always emphasized the importance of the removal of the tooth follicle, and I am more than pleased to hear Dr. Fenton sound a word of warning in this respect. It is fortunate for the patient and the operator that the third class of cyst, the multilocular, or adamantinomas, do not occur so frequently as the other two types, as they are much more difficult to remove, and cause more deformity to the patient.

Theodor Blum, New York City: The question of differential diagnosis in cysts is much more important than we usually think. The one disease that we have to think of is the one which Dr. Fenton mentioned, namely, osteitis fibrosa cystica, or Barrie's disease, Barrie having described this condition. The roentgen shows how easily it can be mistaken for a multilocular cyst. It is not a tumor, simply an inflammation of the bone with cyst formations. From the discussion you have heard of cysts, one would believe that their etiology had been settled. Radicular cysts, we hear, originate from the epithelial cells of the peridental membrane. This is one of the theories, and as much research work has yet to be done on the subject, it should not be accepted as final. We have aspirated quite a large number of cysts to determine whether there was infection present, and we found that the vast majority of cysts are not infected. If infected, they have become so secondarily. We must not forget that cysts can also originate from temporary and supernumerary teeth. I am glad to hear Dr. Fenton say that the antrum is never involved through cysts in the maxillae except when an acute infection of the cyst is the cause of the breaking off of the cyst contents into the antrum. I have only found one case, a case of supernumerary teeth causing the cyst and the acute infection causing an involvement of the antrum. There seems to be some misunderstanding regarding the Partsch operation. The originator of this operation is not Partsch but Heath of England, the first to describe the operation for removal of cysts. According to Partsch, there is a conservative and a radical operation. The displacement of the antrum which is caused by these very large cysts, displacement even of the nasal floor, is readily corrected as soon as pressure within the cyst ceases. Through ordinary breathing, speaking and masticating, the tissues are stimulated so that the antrum regains its normal shape, the nasal floor reaches its normal position and the old cyst cavity flattens out. One cyst which develops around the third molar in the mandible is often overlooked, because so often we neglect taking extra-oral plates of the mandible. All we see on that film is the last molar tooth, not a large cystic involvment. For that reason and in cases similar to the one Dr. Fenton showed of many cysts in different parts of the mouth, I always try to impress on my patient, even though there is only a cyst or a tumor on one side, that all the teeth should be examined by roentgen ray, so that when I discharge my patient, I know his mouth and teeth are in as good condition as possible and I have not overlooked anything. In regard to the first case, which turned out to be a giant cell tumor: We do not study our patients carefully. The roentgen ray showed practically everything. We must interpret it. It is human, they say, to make mistakes. You will not find a distinct outline of the wall of the cyst. It apparently seems to go over into the sound tissue, and that excludes the possibility of a cyst. Sometimes you will find an outline which looks practically like the outline of a cyst, and, in such case, make the mistake of thinking it might be a cyst when it may even be an epidermoid carcinoma.

Dr. Fenton (closing): I wish to emphasize what Dr. Blum has said regarding the etiology of cysts. The etiology given was that which had been taken from texts. As he says, much work can be done before one can arrive at a definite conclusion as regards etiology. He spoke of infection of cysts. I have seen a few infected. They showed their infection after I aspirated. You can draw your own conclusions. It was interesting to hear about hydrops of the antrum. I had never seen that condition and was glad to get the information. I am still at sea, but I hardly think that, after the information I have received, I will use the Berger operation on large cysts for some time.

THE SPHERICAL PRINCIPLE OF OCCLUSION—ITS USE IN DIAGNOSIS AND TREATMENT OF DENTO-FACIAL DEFORMITIES*

By VERNON D. IRWIN, D.D.S., Duluth, Minnesota

THE theory of the spherical principle of occlusion was given to the dental profession a number of years ago by Dr. George S. Monson of St. Paul. It is the result of long years of research and study in an attempt to find Nature's ideal plan of occlusion. Briefly, the theory is this: In the high type, ideal occlusion, the cusps of all the teeth and the center of both condyles conform in the main to the surface of approximately an 8-inch sphere, and the long axis of each tooth converges to the common center of this sphere.

Few of us attain full development and perfection of occlusion of our teeth, because Nature's predetermined plans for the various structures are altered by the influence of nourishment, environment, function and heredity. The degree that our occlusion varies from the ideal can be determined only from a knowledge gained by studying the high type, well developed cases with a full complement of regular and well-posed teeth.

It is the purpose of this paper to show (1) the need for correction of dentofacial deformities; (2) the necessity of a balanced occlusion; and (3) the resulting improvement in facial appearance by correcting malocclusion. I shall not go into the technical steps in mounting the cases or the reconstruction work, but will show (1) a high type, ideal case; (2) a case of dentofacial deformity; (3) the reconstruction of my own mouth from a malocclusion; and (4) photographs of corrected cases.

I shall briefly consider the outstanding features in a case that conforms very closely to the high type.

Figure 1 presents the occlusal view of both arches. The harmonious continuity and symmetry of the arches are evident. All teeth are present.

Figure 2 shows the casts mounted in central occlusion. This is the position generally brought to mind when occlusion is spoken of. There is no movement and the cusps are properly interdigitated.

Figure 3 presents the right lateral position, right view, following a movement of the mandible to the right, guided in the ideal by the right cuspids, until the buccal surfaces of the uppers and lowers are nearly on a vertical line. The amount of occlusal contact in this range should be noted.

Figure 4 shows the opposite side during this same movement. The buccal cusps of the lower are in the position of traveling through the lingual grooves and between the lingual cusps of the upper teeth, maintaining a maxi-

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mum balancing occlusal contact, dividing the stress of mastication equally on each side.

Figure 5 shows the left lateral posi-

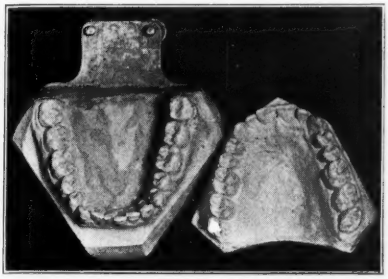

Fig. 1.—A high type, ideal case. The harmonious continuity and symmetry of both arches may be noted.

tion, left view. The mechanical efficiency in such a machine is very evident.

Figure 6 shows the left lateral position, right view. The same amount of occlusal contact in this range is here evident.

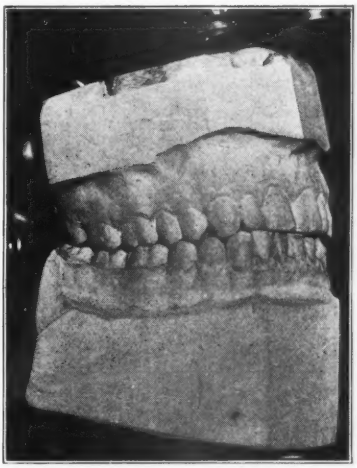

Fig. 3.—Right lateral position, right view. The amount of occlusal contact in this position should be noted. (Case shown in Figures 1 and 2.)

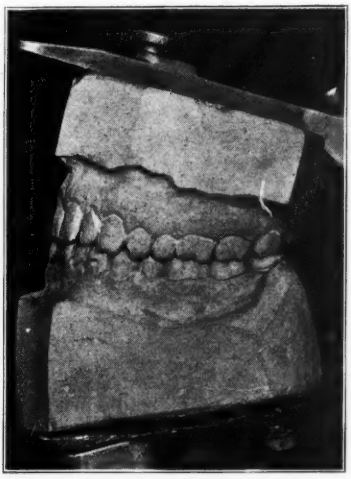

Fig. 2.—A beautiful specimen of normal occlusion and healthy gingivae. (Models shown in Figure 1.)

Fig. 4.—Right lateral position, left view. (Case shown in Figures 1 and 2.) This, with Figure 3, shows a maximum balancing occlusal contact of this ideal case.

Figure 7 shows the forward range. The end-to-end relationship of the anterior teeth, with the cusps of the upper and lower posterior teeth in contact may be noted.

Notice that, through all these ranges, there is a maximum, uniform occlusal contact. Each unit, according to its design and position in the arch, receiving its proper proportion of stress. This is termed "balanced occlusion," and is defined as follows: "That type of relationship between mandible and maxilla (the relationship being maintained through the teeth) which permits a maximum continuous contact of the upper and lower occluding surfaces, through all ranges, from central to lateral and incisal and back to central."

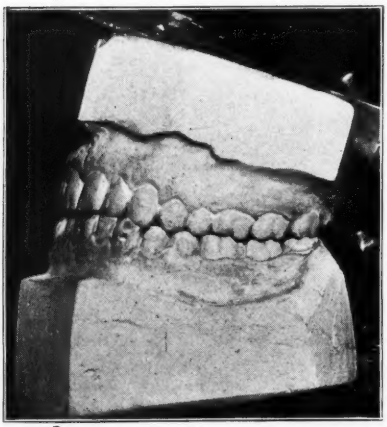

Fig. 5.—Left lateral position, left view. (Case shown in Figures 1-4.) Note what the mechanical efficiency of such a machine must be.

The degree of success of our construction work in dentures and bridges, on single teeth and in orthodontic and periodontic cases depends, other things being equal, on the nearness of our approach to the perfection of a balanced occlusion as shown in Figures 1-7. Dentures, with every element of suc-

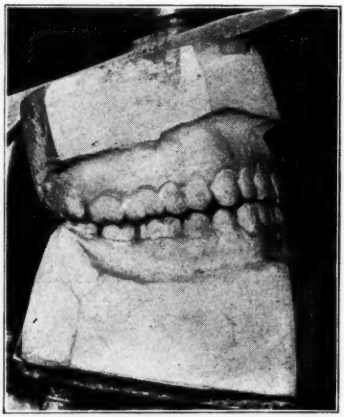

Fig. 6.—Left lateral position, right view. (Case shown in Figures 1-5.) There is the same amount of occlusal contact in this range.

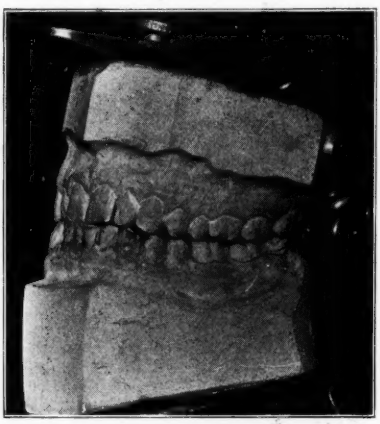

Fig. 7.—End to end relationship. (Case shown in Figures 1-6.) The cusps of the upper and lower posteriors are in contact as well as incisal edges of the upper and lower anteriors.

cess put into them except a balanced occlusion, have failed for the lack of this requisite. Bridges with excellent margins on the abutments, correct tooth anatomy throughout and a nice central occlusion have failed because of the lack of an equal distribution of stress on the proper teeth in all ranges of occlusion. Likewise, the orthodontist fails because consideration, beyond a nice alinement of teeth in central occlusion, is not given to the case. These cases must have the maximum occlusal contact in all ranges to be wholly successful. I believe that it is now generally recognized among periodontists that malocclusion causes most cases of periodontoclasia, and they look to the correction of occlusal abuses to get results.

In the past, our thoughts have been wholly devoted to unit construction, placing a bridge or some other restoration here or there, and being satisfied with a nice looking finished product in central occlusion. What relation this piece of reconstruction bore to the opposing teeth in the other ranges of occlusion never occurred to us, and there failure commenced.

We were never taught to raise our eyes from that little unit in the mouth to the whole mechanism of mastication. We are beginning to see the light now. We are beginning to recognize deformities; deformities that we have produced, possibly, and perpetuated because we did not recognize them, and we cannot recognize the degree of a deformity without having an understanding of the highly developed, ideal type. In our office, we seldom come in contact with anything but deformities, and we should appreciate the responsibility that is ours in correcting and preventing them.

The following classification of deformities, as applied to occlusion, is given by Dr. C. K. Bird of St. Paul and Dr. O. DeForest Davis of Minneapolis:

CLASSIFICATION OF DEFORMITIES

Class 1. Overbite and Overjet Types.

(A) Presents marked overbite, but little overjet. This type of deformity originates in a nearly ideal; and through excessive wear or loss of teeth shows considerable closure. There is pronounced wear in the upper and low incisors, and very often the remaining posterior units, especially the bicuspids, are intruded, owing to excessive and unbalanced stress.

(B) Presents marked overjet and overbite. This type of deformity is usually due to a lack of development of the mandible, which, in turn, constricts the lateral development of the maxilla. Usually shows little wear except on the second molars.

There are combinations of deformities with characteristics of both subdivisions, which may eventually need further classification, but for the present they will all be included in Class 1.

Class 2. Prognathous Types.

(A) Congenital and developmental. Through hereditary influence and improper development, a prognathous condition may be produced in a child, which, if treatment is not instituted, is perpetuated as chronic in the adult.

(B) Acquired. A prognathous condition may be acquired through wear, excessive function and loss of teeth, even though the condition before mutilation was nearly ideal.

Class 3. End to End Types.

Presents with vertical closure only. Always shows excessive wear. Normal arch form maintained, because the

lines of vertical stress are usually unimpaired.

Any of these types may present deflection of the mandible from the median line due to excessive function unilaterally.

By using the spherical principle, it is possible to estimate accurately the amount of the dental deformity and the loss in facial dimension. It is necessary that great care be exercised in the mounting of casts on the instrument. By means of "check-bites" and other technic, which I shall not take time to describe, it is possible to mount casts of natural teeth on the mandibulomaxillary instrument so that every movement of the jaws can be reproduced, and thus the occlusion in all its ranges can be studied, giving information as to the stresses and uses that the various units are put to in mastication.

A thorough diagnosis determining the etiologic factors involved, as well as recognizing the abnormal and pathologic conditions present, must be made before reconstruction is attempted in any case. The diagnosis should be made of the mounted casts in conjunction with the physical diagnosis of the patient's oral cavity and associated parts. I will briefly mention the things that should not be overlooked on the casts and in the physical diagnosis. Keep in mind what you have determined the ideal for the given case would be like, and then note the following on the casts: the vertical, lateral and mesiodistal relation of the arches; amount lost by wear on the teeth; normal and abnormal stresses on the teeth, with the direction of the stress; irregularities in the alveolar process outline; teeth in function and out of function in all the ranges of occlusion; extrusion, intrusion and tipping of teeth with the degree; presence or absence of third molars and other teeth; accommodation of jaws for the teeth, lack of which would indicate an underdevelopment, and impacted teeth. The interdigitation of teeth in central occlusion and the occlusal relationship in all ranges should be noted. To correct the deformity, we must restore vertical dimension and place the mandible in proper relation to the maxilla, giving an interdigitation and occlusion that will insure function and efficiency, and be acceptable from the standpoint of esthetics. We should determine the course of reconstruction; which teeth are to be used as abutments, which are to be built up to the new plane of occlusion, and which are to be left untouched to drift into occlusion.

We must visualize the finished case before we start. No case should be undertaken without due regard to tooth anatomy, interproximal spaces, health of the investing tissues and pulps, well-fitting castings, and the other exacting requirements that are necessary for success in any form of construction. Too much emphasis cannot be placed on this factor.

The physical diagnosis of the oral condition should include, besides full mouth radiograms and front and profile photographs of the face: 1. Examination of the condyles for encroachment on the external auditory meatus. This is done with tips of the little fingers in the patient's ears, and thumbs on the forehead, the mandible opening and closing. 2. Ear test for hearing

with a watch, with record of the results. In some cases, it would be better to have an otologist do the examining. 3. Examination for deflection of the mandible and other deformities, the results of these deformities as regards facial outline and appearance being noted. An abnormal relationship of mandible and maxilla often leads to chronic throat irritation, impairment of the function of swallowing, closure of the eustachian tube, inarticulate speech, buzzing and crackling in the ears and depression of the tongue. 4. Determination of the condition of the investing tissues and habits to be overcome. 5. A general history of the patient.

Diagnosis of a practical case with the accompanying illustrations will give a better idea of what to look for in studying these cases. This is a typical Class 1, division *A*, case of the classification given here previously.

Examination of this patient orally and of the mounted casts reveals the condition shown in Figures 8 and 9.

In Figure 8, the lower right first and second molars have been extracted, with consequent tipping of the third molar mesially and lingually into this space, the occlusal height being reduced as a result of this tipping and constant muscle pull, and thus decreasing the angle of the mandible. The upper right first and second molars were extracted, with consequent tipping of the third molar, mesially and lingually.

Figure 9 shows a case in which the

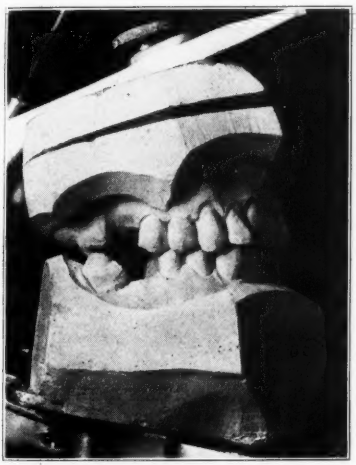

Fig. 8.—Case of dentofacial deformity (Figures 8-18, inclusive); central occlusion, right view. The tipping of the molars and the lack of occlusal contact from standpoint of masticating efficiency may be noted.

Fig. 9.—Case shown in Figure 8. The lower first and upper second molars had been extracted at an early age, and the spaces closed by the tipping of the molars. There is apparently good occlusion, but the occlusal contact in the various ranges of occlusion is evident in Figures 10, 13 and 15.

lower left first molar was extracted at an early age, second and third molars tipping mesially and lingually to close the space left by the extraction of the first molar. This, too, caused a shortening of the angle of the mandible. The upper left second molar was extracted, and the third molar is nearly in contact with the first.

This loss of teeth and occlusal fulcrumage in the posterior region has caused the forces of occlusion to be thrown forward on single rooted teeth, which, by their design, are not intended to carry this load. (Figs. 10-15.)

Fig. 10.—Case shown in Figures 8-18; left lateral position, left view. There is no occlusal contact posterior to the first bicuspids in this range of occlusion.

Figure 10, a left view of the left lateral position, shows no occlusal contact posterior to the upper first bicuspids.

Figure 11, a right view of the cast (Fig. 10) in the same left lateral position, shows no occlusal contact posterior to the upper right central.

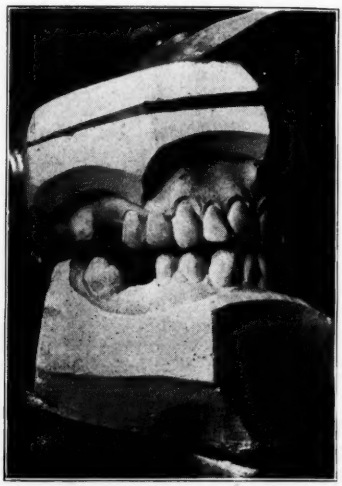

Fig. 11.—Case shown in Figures 8-18; left lateral position, right view. There is no occlusal contact posterior to upper right central incisor.

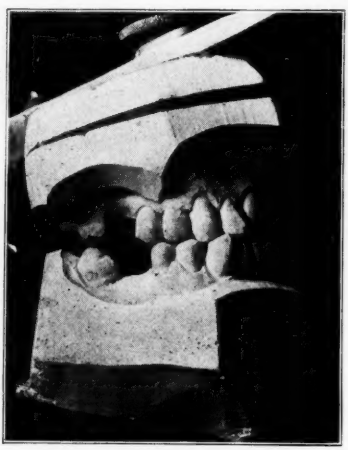

Fig. 12.—Case shown in Figures 8-18; right lateral position, right view. The wear on cuspids and recession of gingival tissues may be noted. Gingival-third cavities are found in nearly all of the cases of this type on teeth that have excessive stress.

Figure 12, a right view of the right lateral position, shows one cusp in occlusal contact in the molar region and contact of incisors and bicuspids on the right side. The amount lost by wear on the upper and lower cuspids is evident, as is the recession of gingival tissue over the upper cuspid.

Figure 13, a left view of the right lateral position, shows no occlusal contact posterior to the upper left central. The great lack of masticating efficiency in this machine is evident.

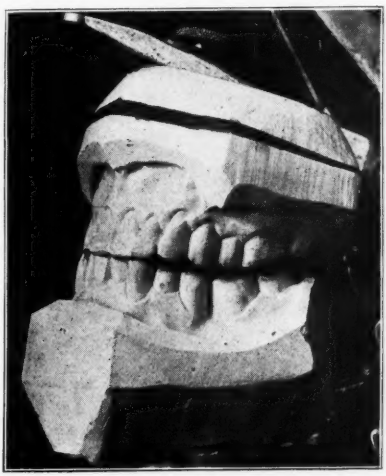

Fig. 13.—Case shown in Figures 8-18; right lateral position, left view. There is no occlusal contact posterior to the upper left central incisor. Great lack of masticating efficiency is evident.

In Figure 14, the end-to-end relationship shows occlusal contact of just four upper teeth and these in the anterior region.

Figure 15 shows that this excessive force on the anterior teeth has ground them off in an attempt to establish a bal-

Fig. 14.—Case shown in Figures 8-18; end-to-end relationship. There is occlusal contact on just the anterior teeth.

Fig. 15.—Case shown in Figures 8-18; end-to-end relationship, left view. The unbalanced forces of this occlusion have narrowed both arches and protruded the anterior teeth.

ance of forces. The unbalanced forces of this occlusion have narrowed both arches and protruded the upper anterior teeth.

The bite has closed, or, in other words, an abnormal occlusal relationship between the mandible and maxilla has been produced. All adjacent structures have likewise been affected, and

Fig. 16.—Case shown in Figures 8-18. A segment of an 8-inch sphere is shown, in the proper place on teeth. The lack of conformity of the tipped and worn teeth to the ideal occlusal plane is evident.

thus a dentofacial deformity has resulted.

To fill the spaces left by the extractions in the generally accepted manner would mean perpetuating this deformity and the various evils resulting therefrom. Failure to consider this mechanism as a whole would result in the ultimate failure of any restorations. This sort of dentistry, our common practice for years, has sorely tried the confidence of our patients and justly so. We have not given them the highest type of service, nor have we recognized

Fig. 17.—Case shown in Figures 8-18, with "positioning guide" in place, indicating the amount of restoration to be made and the ultimate interdigitation and relationship of the mandible and maxilla.

Fig. 18.—Case shown in Figures 8-18, front and profile view of patient showing the facial indications of the dental deformity. The heavy lines on either side of the nose and the lip relationship may be noted. (Compare Figure 19 for greater evidence of facial deformity from dental deformity.)

and prevented the impending destructive elements that we should have seen, as our patients came to us year after year. A great problem and a great challenge for service presents itself in nearly every case of reconstruction that comes before us.

Referring now to the case at hand: corrective dentistry, that would attempt to establish, as nearly as possible, the almost ideal occlusal relationship that existed in this mouth (Fig. 16) before the loss of teeth and the subsequent tipping of others, would render the highest type of service to the patient, and be a credit to the profession. To do this necessitates the opening of the occlusion the amount lost, as shown by the lack of balance in the posterior teeth, plus the amount lost by wear on the anterior teeth.

We establish a common radius to which we build our restorations on all lower teeth below the arc. (Fig. 16.) With the lower restorations completed and in place (not here shown), the remaining occlusal discrepancy, shown by the use of the "positioning guide, (Fig. 17)," is eliminated by restoring the upper posterior teeth to full balance in all ranges with the lowers. We then have reproduced, in this case, occlusal, physiologic and anatomic balance of all the parts and have approximately restored it to its original high type.

Figure 18 (left) is a front view of the patient's face. Figure 18 (right) is a profile view.

Fig. 19.—Left: Patient before restoration work was started; right: when work was completed, two weeks later. The increased vertical dimension between the chin and the nose may be noted. The younger appearance of the patient in the picture to the right is very evident.

Fig. 20.—Profile view of patient shown in Figure 19. The mandible was brought forward and opened to the new position. Figures 18 and 19 show the possibilities of correcting facial deformities by proper correction of dental deformities.

The patient shown in Figure 19 presented a considerable occlusal and facial deformity. She had been wearing a full upper denture against a badly constructed bridge on the lower right side, with considerably worn anteriors, and the lower left bicuspids and molars tipped somewhat, owing to the extraction of the lower left first molar. The occlusal outline resembled that of a badly warped horseshoe, the heels of which bent opposite directions from the original form. This was due to intru-

sion of the molar holding the bridge on the lower right and extrusion of the molars on the lower left.

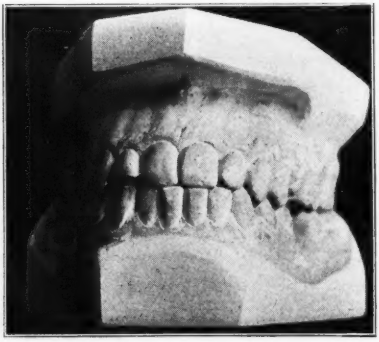

Fig. 21.—Anterior view of the casts of the author's own mouth. The median line is shifted to the left.

Using the spherical principle, fixed reconstruction on the lower, and a new upper denture restored the proper relation of the mandible to the maxilla. Thus, too, all of the structures that depend on the mandible for their position were again restored to their natural position. The mandible was deflected to the right and in a receded position. This was brought forward, deflection corrected and the correct vertical dimension reestablished giving an appearance of a better facial harmony and symmetry. The picture on the left shows the patient the day that I started her work. The one on the right was taken just two weeks later, on the day the case was finished. The increase in vertical dimension is readily seen by comparing the distance between the tip of chin and the nose in the two pictures. The wrinkles about the lips and chin have practically vanished; the heavy lines are decreased; the deflection of the mandible is corrected, and a much more pleasing expression is apparent. Further function and development in this new relation will produce much better results as time goes on.

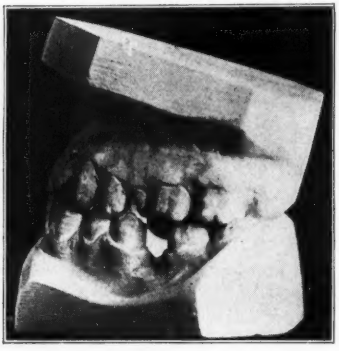

Fig. 22.—Left view of Figure 21, showing extractions and resultant drifting of other teeth. The upper anteriors have been driven out by the forces of malocclusion.

Fig. 23.—Right view of Figures 21 and 22. The upper right molar was receiving all the load of mastication for that side. The anteriors incline forward. (Compare Figure 28, noting how the anteriors have straightened.)

Figure 20, the profile view of the same case, shows the new relationship of mandible to maxilla and the improvement in appearance.

Fig. 24.—Anterior view of case when restoration was completed. The great opening left in anterior region may be noted. (Compare Figure 27.) This opening has entirely closed (August, 1926), two years after completion of the restorative work.

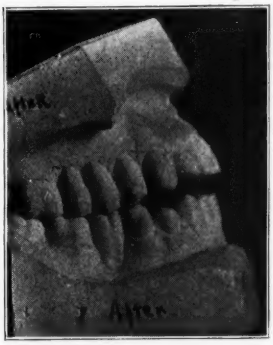

Fig. 25.—Right view of Figure 24, showing restorations made on the posterior teeth only. The anteriors have since drifted together and have become more nearly vertical. (Compare Figure 28, right.)

This patient reports by mail about every two weeks, and a letter written by her about sixty days after the work was completed states that she has noticed a considerable improvement in her hearing. All the letters that she has written have been so appreciative of what was done that it seems they echo a call to service, for real service of this kind, for the many other cases that continually come to our attention nearly every day. These deformities are so nearly universal and the correction of them so beneficial that the profession generally

Fig. 26.—Left view showing restorations made on the posterior teeth only. The opening in the anteriors was left to compensate for the loss of vertical dimension due to the extraction of teeth and the tipping of molars left in, plus the wear on the teeth.

must awaken to its responsibilities in these cases.

Figure 21 shows a cast of my own mouth. The front view shows the end-to-end relation of the upper and lower before the case was started. The anterior gums show no recession or indication of serious trouble.

In the case shown in Figure 22, the lower left first molar was extracted about sixteen years ago. Second molar drifted mesially and lingually. The

upper second bicuspid was extracted, and the upper third molars were extracted about three years ago.

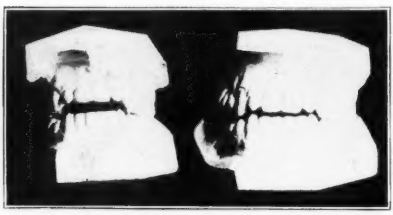

Fig. 27.—Anterior view of casts of author's mouth (left), at the time of the completion of the restorative work and just one year after restorations were made (right). The anterior teeth have drifted together.

In the case shown in Figure 23, the upper right second bicuspid was extracted twelve years ago, and the upper first molar six years ago. The lower first molar was extracted about eight years ago. The movement that has taken place in the molars may be noted. All of them have tipped mesially and lingually. The anterior upper six teeth have been driven out by the forces of

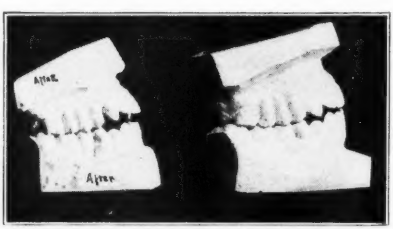

Fig. 28.—Right view of casts of author's mouth (left), at the time of the completion of the restorative work, and just one year later (right). The relationship of the cuspids may be noted in both pictures, also how the anterior teeth are becoming more nearly vertical, the process as well as the teeth.

malocclusion, carrying the whole labial plate of bone with them. The excessive stress on the upper right molar caused neurotic pains in the area over the tooth. This has disappeared since the reconstruction work was completed. Masticating efficiency with that machine was far from normal. The need for a better one was keenly felt.

Reconstruction of the mouth on the spherical principle was started on Aug. 25, 1924, and was completed, Sept. 4, 1924. Dr. C. K. Bird of St. Paul did the work.

Figure 24 shows the anterior view of casts the day that the work was completed. The great opening between the

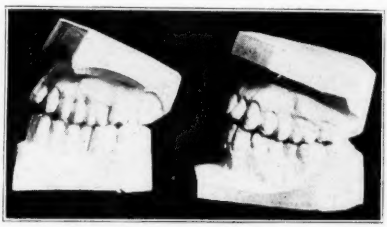

Fig. 29.—Left view of casts of author's mouth (left), at the time of the completion of the restorative work, and just one year later (right). The upper second molar, which was not restored, has drifted into occlusion.

upper and lower anteriors may be noted. It was previously determined in the diagnosis that this amount of opening would compensate for the amount of closure of the bite due to the extractions and tipping, the pushing out of the upper anteriors and the wear on the teeth.

Figure 25 shows the occlusion on the right posterior teeth built up by bridges and castings. No reconstruction was done on the lower eight anterior and upper six anterior teeth. The new occlusal plane is far above the lower right first bicuspid.

Figure 26 shows the left side with a bridge from the upper first bicuspid to the first molar. The second molar was left untouched to drift into occlusion with the reconstructed lower. There is a bridge from the lower left second bicuspid to the second molar and a mesioclusodistal casting on the lower left third molar. The lower first bicuspid is below the new plane of occlusion.

Figure 27 shows an anterior view of casts of my mouth, just one year after the reconstruction work was put in. (Compare with the picture of one year previous.) The opening between the anteriors is almost closed.

Fig. 30.—Left: Patient the day work was commenced, showing facial signs of dental deformity; center: when work was completed, showing the muscle tension in the face due to increasing the vertical dimension between the nose and the chin, with the dental restorations; right: one year later.

Figure 28 shows the right side, one year after reconstruction. The lower right first bicuspid has extruded toward the new plane of occlusion. The upper anterior teeth and labial plate seem to have become more vertical as they approached the new line of occlusion. There was no extrusion of the teeth from the process in this case. The movement seemed to be with the whole plate of bone, upper and lower anteriors.

Figure 29 shows the left side, one year after reconstruction. The lower left first bicuspid has extruded toward the new plane of occlusion. It is now in contact with the upper first bicuspid and is just beginning to be forced buccally by the lingual inclined plane of the upper bicuspid. In handling this case certain movement of teeth was anticipated.

In Figure 30, the picture on the left shows the front view of the patient the day the work was commenced. The typical facial signs of occlusal deformity are present. The picture in the center shows the front view ten days later, the day the work was completed. The muscle tension about the mouth may be noted. The picture on the right was taken just one year later.

Fig. 31.—Profile view of Figure 30. Left: appearance of patient the day restorative work was commenced, showing the protrusiveness of chin although there was an end-to-end relationship of the anterior teeth; center: ten days later, when work was completed, showing muscle tension in the face; right: one year later. The chin is not quite so prominent and the facial lines are not so heavy.

Figure 31, left, shows the profile view the day the work was commenced. Other typical facial signs of occlusal deformity, such as the raised ala of the nose and malrelation of the lips are evident. The picture in the center shows the profile view ten days later. The mandible is not quite so protrusive,

owing to the increase of the vertical dimension. The picture on the right was taken just one year later.

Considerable muscle soreness in the cheeks developed a few days after the work was completed, but this disappeared within a short time. The muscle soreness was due to the new tension placed on them. I lisped considerably for about two months, and there still is a trace of it. The mastication of food is now done with a greater thoroughness and efficiency.

I believe that this sort of reconstruction will give the highest type of service to our patients. We should be satisfied with nothing less. The spherical principle is the only one that I know of permitting accurate diagnosis and an exacting, precise technic to be followed in correcting dentofacial deformities and establishing a balanced occlusion.

We owe our patients the greatest service that is at our command. We must seek out the means of delivering the highest type of service to them though it means much study and sacrifice to do this. As we see only what we are taught to see and know only that which we learn, we must learn to recognize these dentofacial deformities and then correct them. But, better still, let us learn to prevent them by recognizing the early signs of impending dental deformities in childhood.

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DISCUSSION

Roy H. Ellis, Okmulgee, Okla.: It is rather strange that Dr. Irwin should bring a paper of this nature before the partial denture section, as it seems that he has entered the realm of the orthodontist. This paper has given me a clearer vision of the correct principles of orthodontia than any previous articles or clinics that I have heard or attended. It would be well for our orthodontists to familiarize themselves with the type of correction that some of the finished cases we have seen would suggest. Dr. Irwin finds himself vying with the periodontist in these corrections, though not relieving the traumatic occlusion in the same manner, that is, lowering or closing the bite, but rather the opposite; his method is to open it. He has failed to tell us how he determines just the proper amount of opening to make in the correction of any one of the cases here presented. An explanation of this would be fully appreciated. There is one serious objection to the paper as presented: it does not go quite far enough into detail for those of us who know practically nothing of this type of work to be enabled to take back home with us a workable idea as to how we may study the problems as corrected by this procedure. We heartily agree with Dr. Irwin that we must regard the mouth as a whole when placing in it any form of restoration that will afford balanced occlusion, in whatever position the lower teeth may be when in the ordinary or normal process of mastication.

Dr. Irwin (*closing*): I thought that I clearly stated just how to determine the amount the bite should be opened in the case of my own mouth and that presented by the casts of the first case described. In diagnosing either of these cases on the instrument, the following conditions will indicate the amount of the opening of the bite and the replacement of the mandible in proper relation to the maxilla: (1) The malrelation of the jaws themselves; (2) the amount of movement of the teeth from their normal position due to the shifting and tipping of them after extractions, etc., and (3) the vertical dimension lost by wear on the teeth. Dr. Ellis stated that I had not gone fully enough into the technic of reconstruction so that he and others here could take home a workable knowledge as to how to reconstruct a case, using the spherical principle. The technic is so exacting and so precise, and there are so many detailed steps to it, it would be impossible to include it all in this paper.

WHAT IS A NORMAL POCKET?

By B. GOTTLIEB, Vienna, Austria

IN all studies of pathology, we must start from the normal. All studies about periodontoclasia are, in the main, studies about the pathology of the pocket. Until 1920, we all thought that the bottom of the normal pocket was at the cemento-enamel junction. Even in the first contribution to the histology of periodontoclasia by Fleischmann and me[1] this theory was used as a basis. Soon thereafter, I determined, from well-prepared specimens, that we were all wrong about what constitutes normal pockets. A paper on the subject was read in September, 1920, at Leipsic.[2] Since that time, a series of papers about periodontoclasia based upon that new knowledge of the normal pocket have been published in various of our journals. I had thought that investigators of other nations would also study our literature or extracts therefrom which appeared in their own language. In the extensive studies about the normal histology and histopathology published in English in the last few years by well-known authors, we find that the normal pocket is described and depicted as we thought of it before 1920.

I do not desire to present a long paper on my studies in periodontoclasia. But I wish to tell my colleagues who read only papers written in English what a normal pocket is, in order that they may not start with a false premise in studying the histopathology of this region; for when we start from the right point, we can go the right or the wrong way; but when we start from the wrong point, we must go the wrong way.

Before the eruption of the tooth, the outer layer of the enamel epithelium is attached to the enamel surface and the two are grown together. There is no space between the epithelium and the enamel surface. Before the enamel is visible, the epithelium of the mouth and the outer layer of the enamel epithelium grow together, and, through an opening at the point of union, the enamel comes into the mouth. Next, the epithelium detaches itself from the enamel surface gradually as the tooth erupts. When the tooth reaches a position that it is in occlusion with the opposing teeth, we speak of eruption as completed. We previously believed that the bottom of the pocket was now at the cemento-enamel junction. But not so: The detachment of the epithelium from the enamel surface has never, at this period, reached that point. Only about two-thirds of the crown has really come through the gum. The last third is still one with the epithelium, and the

1. Fleischmann, L., and Gottlieb, B.: Dent. Cosmos, 63: 215 (March), 375 (April) 1921.

2. Gottlieb, B.: Deutsch. Monatschr. f. Zahnheilk., 1921.

saliva, for instance, or food or micro-organisms cannot reach this part of the enamel surface. This part is really not yet erupted. In the years following, the detachment goes on. Between the ages of 20 and 30, the bottom of the pocket passes the cemento-enamel junction. I say passes, not reaches. It can never be seen either in man or in animals (we have studied thousands of teeth microscopically) that the bottom of the pocket is at any time around the whole tooth at the cemento-enamel junction. On the one side of the tooth, the bottom passes this point earlier, on another later. But it does not remain at this point one day longer than at another point of the tooth surface. Before the bottom of the pocket reaches the cemento-enamel junction, a pro-

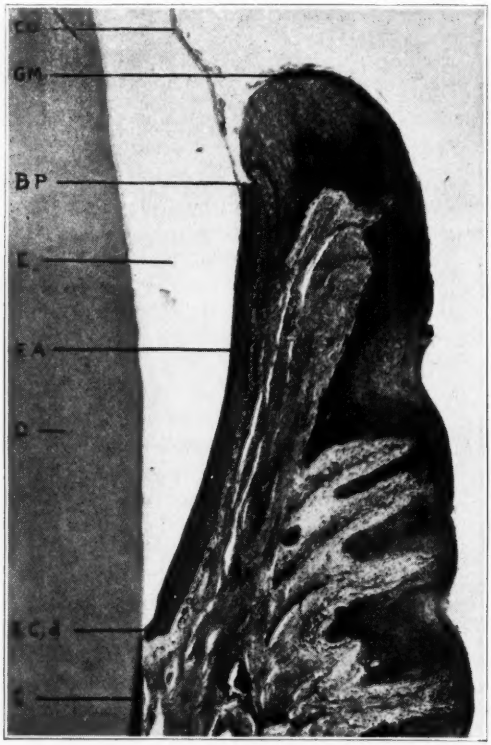

Fig. 1.—Photomicrograph of cross-section of upper left lateral incisor (labial aspect), in a man, aged 22. In this and the following figures, *EC* indicates cemento-enamel junction; *E*, enamel; *C*, cementum; *D*, dentin; *B*, bone; *GM*, gingival margin; *BP*, bottom of pocket; *Cu*, cuticle (Nasmyth's membrane); *EA*, attachment of the epithelium; *a*, end of the epithelium growing apically.

liferation of the epithelium along the cementum begins so that the epithelium is always, to a certain extent, attached to the tooth surface, enamel or cementum. The proliferation of the epithelium has already been described.[1] A microscopic section of any artificially decalcified tooth with the surrounding soft tissues in an individual not too old, has an empty space in the position of the dissolved enamel, but the cuticle remains intact and in position or partly in position. If the latter is not greatly disturbed, one will find that it is attached to the epithelium and will easily find the real bottom of the pocket. I hope that investigators may now start from this new point, and I wonder if they can reach any other conclusions than those here presented.

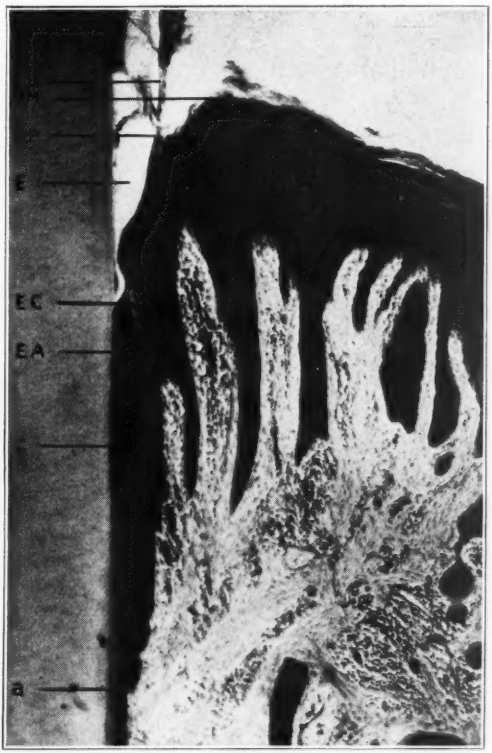

Fig. 2.—Photomicrograph of cross-section of lower left second bicuspid (mesial aspect), in a man, aged 24.

The value of this new point of view, in practice, is, in some instances, important. Some other findings in connection with this subject, especially concerning the cuticle, are published in our journals.

In Figure 1, the bottom of the pocket is not at *EC* but at *BP*. The fact that the enamel *E* has disappeared through decalcification has been overlooked. The cuticle *Cu* is the outer surface of the crown. The pocket is very shallow. Writers have given the normal depth of the pocket as the distance from *GM* to *EC*. Therefore, they designate 2 mm. as the normal depth. But this is not the fact. There are to be found pockets with really no appreciable depth. In Figure 2, the part of the enamel from *BP* to *EC* is not yet erupted. As for the cuticle, the enamel-surface has detached itself only as far as the point *BP* and the remaining part is still one with the epithelium. The attachment of the epithelium to the root surface extends from *BP* to *a*. In both Figure 1 and Figure 2 (note the ages, 22 and 24, respectively), the crowns are really not yet erupted. The

Fig. 3.—Photomicrograph of cross-section of upper right second bicuspid (distal aspect), in a man, aged 30.

enamel surfaces from *BP* to *EC* could be reached neither by saliva nor micro-organisms.

In Figure 3, we see, by chance, the totally erupted enamel. The bottom of the pocket and the dento-enamel junction are at the same point: *EC-BP*. The attachment of the epithelium extends to *a*. On other specimens of this tooth, it can be seen that the bottom of the pocket is at some points still on the enamel surface and in others already on the cementum.

In Figure 4, the bottom of the pocket BP has already passed the cemento-enamel junction *EC*. The epithelium attachment extends from *BP* to *a*. Here, not only the whole crown is erupted but also a part of the root (from *EC* to *BP*).

Fig. 4.—Photomicrograph of cross-section of upper left first molar (labial aspect), in patient referred to in Figure 1.

A STUDY OF THE BLOOD IN CASES WITH DENTAL INFECTION: PRELIMINARY REPORT*

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THE general theory as to the rôle of focal infection in bringing about systemic disease supposes the existence of an area of lowered resistance wherein micro-organisms can persist, develop attacking qualities and discharge the products of their activity, together with some of their number, into the blood or lymph of the host. As a result of this continuous diffusion and distribution of these bacteria and bacterial toxins, pathologic alterations may appear in other parts of the body; and such areas, in turn, can also become active points of dissemination and act as secondary foci. Since the recognition and announcement of such possibilities, the literature has been crowded with reports of instances in which systemic disturbances were entirely relieved on the eradication of such infected areas, and among these are many in which the teeth, with their supporting and investing structures, were involved.

There are many cases like these that seem to be in accord with the terms of the theory. Possibly less encouraging is the word from many whose complete natural denture had been taken away without the reward of anticipated benefits. The explanation offered for the failure of this group of cases to respond to interference has been that all foci had not been eliminated, or that the secondary morbid relationship had been strained to a point beyond the possibility of repair and return to function. On the other hand, a third group of individuals is seen with diseased mouths in which no symptoms can be found elsewhere. Vital resistance and natural immunity to this type of infection may be present in this group and continue to prevent changes, until suitable or sufficient strain has been placed on the physiologic functions to produce an area of lowered resistance and susceptibility.

When a clinician is called on to make a diagnosis in these cases, his main reliance has been the clinical examination, the roentgen ray and the various vitality tests. In a great number of cases, he is at a loss to know what constitutes sound practice, for he has no way of telling whether or not a patient is absorbing harmful bacteria or toxins, and

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what is most advisable before a critical point or break in resistance is reached. Physicians and surgeons in their fields are constantly referring to the blood records, in order to correlate them with other laboratory findings and clinical examinations. Logefiel[1] presents an excellent paper on the value of the blood smears in those fields. He shows that a complete diagnosis of some diseases can be made from the blood smear, that it is a great aid to diagnosis in other cases and that it is of great value in determining the prognosis in a third group of cases.

In view of the fact that the blood is a medium for distributing toxins through the body, a great deal of work has been done on it, in the hope of devising a means for obtaining a more complete picture of the condition of the patient with latent infection in and about the teeth. Serious attempts have been made to associate chronic infections and blood findings, but few of them have been concerned with the morphologic changes in the blood cells. It is essentially from this angle that this work is being done.

LITERATURE

In reviewing the literature of the work that has been done from the hematologic aspect of the problem of focal infection, one finds little agreement on the blood picture of such cases. Crance[2], in a review of 200 cases of chronic focal infection of oral origin, reports that there is an outstanding leukopenia. Daland[3] concludes, from a hundred cases of chronic periapical infection in adults in which all cases complicated by a focus of infection elsewhere were excluded, that small cell lymphocytosis, with a corresponding decrease in polymorphonuclear neutrophils, is an important diagnostic sign of periapical dental infection, the value of which is increased when leukopenia coexists; that, lymphocytosis will disappear after the removal of all foci of infection, and that lymphocytosis persisting after the removal of periapical infection indicates the presence of an undiscovered focus. Logan reports that, in 162 consecutive cases of chronic oral infection associated with the teeth, 100 cases had shown that blood changes had occurred which were held to be the sequence of such infection about the teeth. Neither pronounced nor moderate anemia was commonly associated with chronic oral infection in this series. He found that leukopenia was more constant in those cases in which pyorrhea pockets did not involve the root ends; and that leukocytosis was associated with pyorrhea cases when pyorrhea pockets extended nearly to or did involve the root ends. Leukocytosis was found in forty-seven of fifty-two cases of periapical infection without discharging sinuses. Goadby[4] finds that, in cases of pyorrhea with variable symptoms, there is a total decrease of white cells, a slight increase in juvenile cells,

1. Logefiel, R. C.: Value of Blood Smear Examination in Surgery and Medicine, J. Lancet, 44:617 (Dec. 15) 1924.

2. Crance, A. M.: Review of the Blood and Urine in 200 Cases of Chronic Focal Infection of Oral Origin, Med. Rec. 100: 633 (Oct. 8) 1921.

3. Daland, Judson: Lymphocytosis as a Diagnostic Sign of Chronic Periapical Dental Infection in Adults, J.A.M.A., 77: 1308 (Oct. 22) 1921.

4. Goadby, Kenneth: Diagnosis of Latent Infection About the Jaws, J.N.D.A., 9: 373 (May) 1922.

a decrease in polymorphonuclears in all cases, and always a high mononuclear count in severe cases. Hecker,[5] after a study of 250 stained blood films in pyorrhea alveolaris, reports tinctorial changes and an increase in large lymphochytes. The variations in the differential counts are as follows: polymorphonuclears, 45 to 65 per cent; large lymphocytes, 15 to 30 per cent; small lymphocytes 5 to 15 per cent; eosinophils, 1 to 3 per cent; mast cells, 1 to 2 per cent; transitionals, 1 to 3 per cent; degenerated leukocytes, variable in number. The large lymphocytes are described by him as follows: 1. The nucleus stains reddish violet to pale reddish violet, or intense blue to very pale blue, while others stain only faintly.

TABLE 1.—SUMMARY OF DENTAL FINDINGS

Case	G	SP	MP	EP	PT	RA	NA	F	CA	BR	MISC
1	X	X									
2		X									
3					X		X				
4	X	X			X	X			X		
5					X	X					
6					X		X				
7	X	X			X	X					
8	X				X		X				
9	X	X				X			X		
10			X		X	X	X				
11		X			X	X	X				
12					X	X		X			
13	X	X			X	X	X	X			
14	X				X		X				
15	X										
16	X			X							
17					X	X	X				
18	X										Buried Impaction
19	X		X								P. O. Socket Infection
20	X					X				X	
21	X		X								
22	X		X		X	X	X		X	X	
23	X		X		X	X	X				
24					X	X			X		
25	X										

*G, gingivitis; SP, slight pyorrhea; MP, moderate pyorrhea; EP, extreme pyorrhea; PT, pulpless teeth; RA, radiolucent areas in radiogram; NA, no areas in radiogram; F, fistula; CA, cystic area; BR, buried roots.

5. Hecker, H.: Study of 250 Stained Blood Films in Pyorrhea Alveolaris, Am. J. Med. Sc., 149: 889 (June) 1915.

2. The chromatin granules in the nucleus are variable in size and shape with no definite arrangement. The cytoplasm stains reddish violet to pale blue. The degenerated polymorphonuclears also present a very interesting picture. The lobes of the nuclei of these cells are widely separated when compared to their normal position in the cytoplasm when the cell is intact. The granules likewise are scattered over a considerable area. The nuclei and the granules of the degenerate cells are variably stained. Some of the nuclei are reddish violet; others are stained various shades of blue, while others are scarcely stained at all. The granules are stained many shades of reddish violet, blue or red.

Price[6] condenses his conclusions to the statement that "dental infection may produce very serious changes in the blood and sera of the body, some of which are leucopenia, erythropenia, lymphocytosis, and hemophilia." Lewis[7] reported a number of cases of dental infection positively diagnosed, in which the differential leukocyte counts showed marked increases in basophilic cells. He indicated that it would be easy to eliminate such conditions as cancer, actinomycosis, various skin diseases, splenomyelogenous leukemia, chlorosis and septic bone diseases as the possible cause of the increase in the basophil count. Positive radiographic findings, together with a high basophil count, are, in his opinion, rather definite evidence of the presence of factors contributing to the condition. Toren[8] says that "there is a particular type of leucocyte present in the blood of patients having infection about the teeth." He finds a cell, which he calls the oral infection cell and describes as

> A large lymphocyte, the outline of which is usually irregular in contour, the cytoplasm of which has not the robin's egg blue of the normal large lymphocyte, but which has instead a peculiar greyish, grainy appearance. The nucleus is always irregular in contour and stained with a moderate degree of density. The nucleus is frequently ameboid or ovoid with one flattened side. The cytoplasm of these cells frequently exhibits vacuoles and acidophilic granules. The noteworthy features of the blood picture of oral infection are: a mild secondary anemia, a low leucocyte count, a relative lymphocytosis in which the large lymphocytes present the greatest increase, the presence of Türk irritation forms, and last, but most important of all, the peculiar character of the large lymphocytes. We have never found these leucocytes present in the blood of a patient who did not have oral infection, nor have we ever had a case of oral infection which did not have these leucocytes present.

Walter[9] found the cells described by Toren in more than 98 per cent of all blood specimens examined in his laboratory. He does not think the Toren cell is a lymphocyte. He says:

> It seems to be an irritated monocyte. . . . If this proves to be the case it may well be evidence of a blood toxin, though not the result of submaxillary gland activity, and if so, it may be given these characteristics, by any focus of infection that is generating such a toxin. Perhaps we shall find that these

6. Price, Weston A.: Dental Infections, Vol. 1, 2. Cleveland, Penton Publishing Company, 1924.

7. Lewis, E. F. Quoted by Rickert, U. G., and Palmerlee, Faith: Comparative Study of Total Salivary and Blood Calcium in Varying Types of Individuals with Special Reference to Cases of Pregnancy. II. Focal Infection, J.A.D.A., 11: 783 (Sept.) 1924.

8. Toren, J.: Diagnosis of Oral Infection by Blood Examination, Dent. Cosmos, 64: 917 (Sept.) 1922.

9. Walter, Will: Teeth and Eye Relations, J.A.M.A., 85: 1720 (Nov. 28) 1925.

toxins develop more largely from teeth than from other foci, because they result from anaerobic growth of streptococci in areas of low oxygen tension. . . . In about one-half of my cases the ratios were changed by the elimination of foci in the way that they should be, to be in accord with this theory; in the others, it was not improved by dental surgery.

Haden, as the result of a study of 200 cases in which 100,000 white cells were counted, concludes that patients with periapical abscesses show a slightly higher total white count than those having no abscesses. The difference is somewhat marked in those patients suffering from systemic disease of focal origin. The increase for the most part is in the polymorphonuclear count, although all types show some increase. Patients suffering from chronic periapical dental infection do not show typically a lymphocytosis. He found no evidence of an unusual type of white cell, or a tinctorial reaction in chronic dental infection.

TABLE 2.—DIFFERENTIAL COUNTS

Case	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Polymorphonuclear	65	47	51	59	49	63	46	55	60	56	48	58	49	47	51	47	48	55	57	42	54	56	51	53	63
Microlymphocyte	4	6	4	5	6	0	2	7	3	11	7	5	12	13	8	12	9	8	10	3	12	7	3	10	9
Leukocytoid microlymphocyte	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	4	0	0	0	0	0	0	0	0	0
Mesolymphocyte	10	14	14	12	12	14	10	5	5	10	14	10	8	12	9	7	6	11	8	15	10	6	8	11	4
Leukocytoid mesolymphocyte	7	8	12	9	12	9	22	18	2	9	10	8	12	4	10	9	13	8	10	12	9	12	12	12	7
Macrolymphocyte	0	0	0	0	2	0	1	0	2	1	0	1	0	0	0	9	9	0	0	8	2	1	0	0	0
Leukocytoid macrolymphocyte	0	0	0	3	0	1	3	2	5	1	0	6	1	0	4	0	7	1	2	0	0	6	3	1	2
Eosinophil	1	3	2	3	2	0	3	3	2	4	3	1	3	2	1	2	2	4	3	1	3	1	1	3	2
Mast	0	1	2	0	2	2	3	2	2	0	1	0	2	2	1	0	1	2	0	3	0	0	3	2	1
Monocyte	2	5	1	3	2	8	1	6	7	3	12	5	9	2	6	2	1	1	6	6	1	8	12	0	10
Transitional form	8	10	9	4	9	3	7	0	9	2	1	5	3	8	6	4	2	5	3	5	6	0	5	7	1
Degenerate	3	6	5	2	4	—	2	2	3	3	4	1	1	3	4	4	2	5	1	5	3	3	2	1	1
Miscellaneous	*					*																			

*1 Plasma Cell.

TECHNIC, MATERIALS AND CLASSIFICATION

For the purpose of making a preliminary survey, smears were made in twenty-five cases with various types of dental infection. No attempt was made to secure a thorough physical examination for the patients, as will be done with subsequent cases. These patients when questioned about the general health, as they would be by the average dental practitioner, replied that they were feeling well. These patients all had manifestation of an oral pathologic

condition, such as gingivitis; pyorrhea, both with and without pulpless teeth; pulpless teeth showing radiolucent areas about their apices in the radiogram, and without such areas; cystic areas, both uncomplicated by other mouth conditions, and with other mouth conditions and impacted teeth; and in one case (19) of postoperative infection of a lower third molar socket, there was trismus and a definite involvement of the submaxillary lymph glands. (See summary of dental findings.) Another group of cases was selected in which no evidence of any type of dental infection could be found. Part of this group were individuals who were selected because they were at first thought to be normal, but on medical examination, were excluded from the normal group. These mouths were normal. Full mouth radiograms revealed no pyorrhea or treated teeth. Case 26 was that of a man, aged 21, in good health but with a slight hypertension; Case 27, a man, aged 21, who had had headaches; Case 28, a youth, aged 19, with marked nasal obstruction on the right side. The following cases were selected from the University Hospital. No evidence of dental infection was found in these cases. In Case 29, that of a girl, aged 14, the blood was taken nineteen days after an appendectomy. In Case 30, that of a girl, aged 15, a diagnosis of chorea and rheumatism was made. In Case 31, that of a woman, aged 20, the blood taken before a goiter operation.

As this preliminary study involves principally the structure of the blood cells, no total red or white counts, or hemoglobin determinations, were made. The technic of making usable blood smears is of importance, hence it will be reviewed here. All blood smears were made by the two cover glass method because of the more frequent uniform distribution with less distortion of the cells. Minimum distortion of the cells is of paramount importance. It has been noted that differential counts which were made from smears on glass slides have been found to vary in different parts of the same smears. Only those cover glasses measuring 0.17 mm. or less in thickness were used, and they were cleaned in the following manner: acetic acid bath; distilled water rinse; 95 per cent alcohol rinse, and were dried with lintless gauze and quickly passed through a Bunsen flame. Thorough cleansing and flaming the slides aid materially in making good smears. Blood was taken in all cases from the finger tips and the preparations were dried as quickly as possible by fanning them through the air. Grübler's Wright's stain powder was mixed with acetone-free, chemically pure methyl alcohol, and only freshly distilled water was used in the staining routine, as water that has stood for some time in glass bottles is unfit for use. The smears were flooded with concentrated stain for one minute, then diluted with the distilled water until a visible metallic scum started to form. This was allowed to remain for two and one-half minutes. The covers were then washed for four minutes, dried with lintless filter paper, and mounted, smear side down, in dammar. A well stained slide brings out the maximum of contrast between the structures in the cells. The erythrocytes are a clear pink, and the

azure granulation in the blood platelets stands out sharply.

Under normal conditions, only adult forms are found in the blood stream, and their morphologic variations are limited. Any changes in the morphology of the cells are due either to immaturity, to the presence of the younger forms as they appear during the various stages of maturation, to functional activity, or to the direct action of a toxin on mature cells in the circulating blood. The changes caused by toxins are variable, and include an increase in cytoplasm, azure granulation, changes in the staining reaction and the development of atypical nuclei. Nageli[10] shows figures (Tafel III, VI and VII, "Blutkrankheiten und Blutdiagnostik") of toxically altered leukocytes with intense granulation, vacuoles and swollen and lobulated nuclei. Alder* has a very good plate showing the action of toxins on the cells in infectious diseases. He believes that the morphologic changes in the white cells resulting from such action can be used as an aid to diagnosis, and that they are of special value as an indication of the degree of toxicity, as well as of the reaction on the part of the individual. They are of greatest importance, therefore, when considered from the standpoint of prognosis. He demonstrates changes in the nucleus as well as in the cytoplasm, which he considers equally important. The most important changes in the nucleus are clumping of the chromatin, with some blurring, vacuolization and increased segmentation. The most important changes in the cytoplasm are a variable grayish blue, indicating a basophilic reaction, and vacuolization, which is marked in cases of great toxicity. The granules also show some changes, such as loss of uniformity of size, color and intensity of staining reaction, with irregular distribution and changes in their number. The eosinophils take on a blue-grayish hue, and there is definite diminution in the number and variation in the position of the granules. The monocytes show bizarre shapes of the nucleus with heavy azurophil granulation as well as vacuolization. Cabot,[11] Bloedorn and Houghton,[12] Longcope, Sprunt and Evans,[13] Graham, and Downey and McKinlay[14] report the occurrence of abnormal leukocytes in the blood in acute infections. The works of Pappenheim,[15] Maximow,[16] Fer-

10. Nageli, Otto: Blütkrankheiten und Blutdiagnostik. Leipzig. Von Veit and Co., 1923, Ed. 4.

*Alder, A.: Changes in Leukocytes in Infectious Diseases, Schweiz. Med. Wchnschr., 51-440 (May) 1921.

11. Cabot, R. C.: Lymphocytosis of Infection, Am. J. M. Sc., 145: 335 (March) 1913; Clinical Examinations of the Blood, Ed. 3, Revised, New York, William Wood and Company, 1924.

12. Bloedorn, W. A., and Houghton, J. E.: Occurrence of Abnormal Leucocytes in the Blood in Acute Infections, Arch. Int. Med., 27: 315 (March) 1921.

13. Sprunt, T. P., and Evans, F. A.: Mononuclear Leucocytosis in Reaction to Acute Infections, Bull. Johns Hopkins Hosp., 31: 357, 1920.

14. Downey, Hal, and McKinlay, C. A.: Acute Lymphadenosis Compared with Acute Lymphatic Leukemia, Arch. Int. Med., 32: 82-112 (Jan.) 1923.

15. Pappenheim, A.: Atlas der menchlichen Blutzellen, 1909, Sup. Band-Erste Lieferung, 1911. Jena, Gustav Fischer.

16. Maximow, A. A.: Relation of Blood Cells to Connective Tissue and Endothelium, Phys. Rev. 4: 553 (Oct.) 1924.

rata,[17] Downey,[18] Dachakoff[19] and others show the subsequent stages in the development and maturation for each series of blood cells to the adult form, and present excellent plates of these various stages. In classifying the cells as found in the stained dry smear, the following features were observed: 1. Relative sizes of cells. 2. The nucleus as regards the total amount of chromatin, relative amount as compared with parachromatin, the arrangement and staining reaction of chromatin, the outline of the nuclear membrane and the size of nucleus. 3. The cytoplasm as to staining reaction, presence or absence of granules, character of granules when present, i. e., shape, staining reaction, number and distribution. 4. Position of the nucleus in the cell. 5. Relative size of the nucleus to cytoplasm.

The cells are divided into two main groups, the red cells, or erythrocytes, and the white cells, or leukocytes. The red cells are the most abundant. They stain pink, with the center a trifle lighter than the periphery. The white cells are fewer and are composed of various types of cells.

The polymorphonuclear neutrophil, or special cell, has cytoplasm which is oxyphilic and contains slightly reddish staining granules of uniform size and distribution throughout the cell. The nucleus is lobulated and may possess three, four, five or six lobes. After the neutrophil has entered the blood stream, its nucleus usually has three lobes, connected by thin chromatin bands. Apparently, the increase in number of the lobes is due to cell ageing. The myelocyte and metamyelocyte, which have one and two lobes, respectively, are the younger forms, and are always pathologic forms when found in the circulating blood.

The eosinophil has faintly bluish cytoplasm which is filled with acid staining eosinophil granules. They take more of the acid dye and are larger than the neutrophil granules. The nucleus is lobulated but not so much as in the polymorphonuclears, and usually has two lobes presenting a saddle shape with a broad connecting strand, but may have three lobes. One can distinguish between a polymorphonuclear and an eosinophil from the character of the nucleus.

In the basophil or mast cell, the nucleus is also lobulated and the cytoplasm is filled with metachromatic and basophil granules. These granules are readily soluble in water, so that, during the process of staining, some of the granules may be washed out, vacuoles being thus produced in the cytoplasm instead of granules.

The lymphocytes may be divided into six groups, as shown in the accompanying illustration.

(*a*) Microlymphocytes (above, left) are small lymphocytes with the chromatin more or less blocked in clouds which

17. Ferrata, A.: Le Emopatie, Parte Generale. Soc. Edetrice Libraria, Milan, 1923.

18. Downey, Hal: Origin and Development of the Eosinophil Leucocytes and of Hematogenous Mast Cells in the Bone Marrow of Adult Guinea Pig, Folia Haematol., 19: 148, 1905.

19. Danchakoff, Vera: Untersuchungen über Die Entwicklung des Blutes und Bundegewebes bei den Vögeln. Anat. Hefte. Vol. xxxvii, p. 473, 1908; Contributions to Embryology, with Complete Bibliography, 9: 1, Carnegie Inst. of Washington Pub., 1920; Origin of the Blood Cells, Anat. Rec., 10: 397, 1915.

fade out into the parachromatin. The cytoplasm is a very narrow rim of blue. An aged cell develops more cytoplasm, which at the same time also becomes more hyaline, so that this cell is classified as a (*b*) leukocytoid microlymphocyte (above, right). The internal structure of the nucleus remains the same as in the microlymphocyte.

(*c*) In the mesolymphocyte (center, left), the nucleus has apparently swelled so that there is a looser chromatin structure and relatively more parachromatin. The cytoplasm shows as a narrow rim. These, too, can develop more cytoplasm and become:

(*d*) Leukocytoid mesolymphocytes (center, right), in many cases showing azure granulation and small vacuoles.

(*e*) Macrolymphocytes (below, left), the result of still further growth, presenting a nucleus with few chromatin masses. The structure is fairly uniform. These can likewise become (*f*) leukocytoid macrolymphocytes (below, right).

In any of the above described forms, azure granulation may become abundant or the cells become larger. A mesolymphocyte may actually be smaller than a microlymphocyte, but the distinction is made according to the internal structure of the nucleus. In a paper on lymphadenosis, in which the occurrence of abnormal lymphocytes is described, Downey[14] says

> The size and form of the nucleus are of little value in determining genetic relationship or stage of differentiation of the cells, but the quantity and distribution of chromatin and its relation to the parachromatin is of great importance. This is the principle which has been emphasized time and again by Pappenheim and which is now universally recognized by hematologists who are working on the pathologic side of blood. Pappenheim believes that the form of the nucleus and its relative size determine the age of the cell at any particular stage of differentiation. In other words, it is possible to distinguish between morphologic characters which are due to immaturity and those which are due to the process of "ageing" and further differentiation. Their state of differentiation is read from the inner structure of the nucleus, while the age of the cells and their functional activity are expressed by the lobulation of the nucleus, the vacuolization of the cytoplasm, the large amount of hyaloplasm and the azure granules. Signs of cell ageing may also be seen in immature cells.

Monocytes have a gray or slate-colored cytoplasm which contains azure granulation differing from that found in the lymphocyte. It is more dustlike, giving the cytoplasm a ground glass appearance, and of a different tint from that of the lymphocyte. The nucleus has a specific structure. The arrangement of chromatin gives a striped appearance to the nucleus. Some of the monocytes have a round nucleus, while others have nuclei having indentations that may even produce a lobulated nucleus.

FINDINGS

The findings, in the group of cases studied, are interesting because of their variation. Some of them (Cases 10, 11, 17, 18 and 25) show little or no change in the structure of the blood cells from that found in blood usually taken as normal, while others present more marked changes. In Cases 6, 9, 12, 15, 19, 22 and 23, the polymorphonuclears are dotted with a dark granulation. The monocytes are also filled with the same kind of granulation. This granulation is like that shown by Alder in his drawings of toxically altered cells. The lobulation of the nuclei varies. Some cases have more cells with indented nuclei than others. In Case 14

there was evidence of a mild secondary anemia. Case 15 showed a number of metamyelocytes. The mouth condition was fairly good so that there was undoubtedly some other cause for this. All cases have a number of leukocytoid mesolymphocytes, many of which have a clear hyaline cytoplasm, while the cytoplasm of others has areas of more intense blue. Many of these cells possess azure granules of various sizes; others have none. Many of the cells have vacuoles in the cytoplasm. Some cases (5, 7, 9, 10, 12, 16, 17, 20, 21 and 22) have a few macrolymphocytes. These larger cells have comparatively simple nuclei, but do not approach the lymphoidocyte nucleus in simplicity. In these lymphocytes, the nuclei still maintain the characteristic lymphocytic structure with the chromatin arranged in diffuse clouds in the parachromatin; while the lymphoidocytes have the chromatin finely divided and evenly distributed, giving the nuclei a sievelike appearance.

Lymphoidocyte is the name given to a certain form of cell that many hematologists believe to be a polyvalent cell which is capable of differentiating into any of the various types of blood cells. These cells are never found in the circulating blood during health, but do get into the blood stream in the various leukemias.

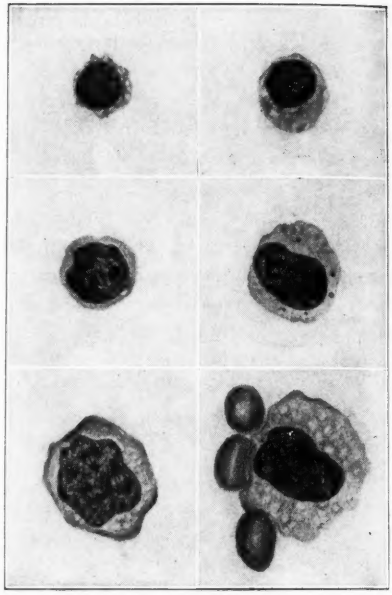
The cytoplasm of the leukocytoid macrolymphocytes is a clear blue, although some of them have small areas at the rim of the cell that are slightly more basophilic. Many of them have vacuoles and azure granules in the cytoplasm. Accordingly, these cells are aged lymphocytes. But few leukocytoid microlymphocytes were found.

Occasionally, cells were seen that seemed to answer the description of what Hecker believes to be degenerated cells. These are possibly fragile leukocytes which have been broken and are few in number. Single cells can be found here and there about the smear that have ruptured cell membranes, distorted nuclei and scattered and stained granules. The character of the granules often helps to identify the cell, but sometimes only the naked nucleus is seen, and is so drawn out that it is impossible to classify such a structure into any of the cell groups. The fact that these cells are surrounded by intact cells seems to indicate that their original condition as well as the technic employed has a bearing on their presence.

We find no cells that answer to the description of Toren's oral infection cell. The leukocytoid macrolymphocytes most closely approximate his cells. In some cases, a few leukocytoid macrolymphocytes are seen, but these are not constant in all smears. Leukocytoid mesolymphocytes, macrolymphcytes and leukocytoid macrolymphocytes were seen in Cases 26, 27, 28, 29, 30 and 31. In many of these cells, large azure granules were seen in the cytoplasm. In those six cases, there was no evidence of dental infection. Each of the following cases had one or more manifestations of dental infection: 1, 2, 3, 5, 11, 14, 16, 20 and 21. No leukocytoid macrolymphocytes were seen in the smears in any of these cases. This would seem to indicate that these cells are not specific for oral infections. Toren states that there are acidophilic granules in his lymphocytes. We have failed to find them. A few duplicate smears of samples of blood that showed granules

in the cytoplasm of some of the lymphocytes when stained with Wright's stain were also stained with May-Grünwald stain. This is also a methylene blue eosin stain which contains no azure component as does Wright's stain. With this stain, these granules are unstained, thus proving them to be azurophil and not eosinophil granules. Duplicate smears were stained in Cases 29 and 30 with May-Grünwald stain. No granules were stained in the cytoplasm of any of the lymphocytes.

Pappenheim[15] has beautiful plates (Plate 28, Prot. 46, Supp. Part 1) of blood cells stained with May-Grünwald stain, in which the lymphocytes show no azure granules. There are two eosinophil cells in which the eosinophilic granules are beautifully stained. He shows another plate (Plate 24, Prot. 48) of normal blood stained with May-Giemsa (Pappenheim) in which there are numerous lymphocytes that have stained azurelike granules in their cytoplasm. Lippman,[20] in a comparative study of azure granules under normal and pathologic conditions, in which the blood of several species of laboratory animals as well as human blood was studied, found that azure granules are inconstant and cannot be used to characterize a cell; that the occurrence of azure granules is the same in the blood in anemia as in the normal blood of the human; and that the small number of lymphocytes containing azure granules when the white count was high, and the much greater frequency of these cells when the count was low (in a case of



Lymphocytes from smears stained with Wright's stain; from Case 12, except the cell shown above, right, which is from Case 14. (Camera lucida drawings with the drawing stage at the same level for all cells. B. and L. imm.; objective, 1.9 mm.; ocular, 7.5.) Above, left: microlymphocyte. The smallest form, having a narrow rim of cytoplasm. Above, right: Leukocytoid microlymphocyte. The nucleus has same characteristics as nucleus in cell above, left, but with larger amount of cytoplasm. Center, left: mesolymphocyte. Medium sized lymphocyte with relatively more parachromatin in nucleus than cells shown above. The narrow rim of cytoplasm may be noted. Center, right: leukocytoid mesolymphocyte. The cytoplasm contains several large azure granules. Below, left: macrolymphocyte. The nucleus has a very loose network of chromatin with relatively more parachromatin than found in the cells shown above left or center left. The size of the nucleus as compared with the size of the entire cell is proportionately the same in the cells shown to the left. Below, right: leukocytoid macrolymphocyte. Three red corpuscles were drawn to show the relative size of all cells when compared to them. A nucleolus is seen in the nucleus at the left border. The cytoplasm contains some azure granules and vacuoles. This is the largest form.

20. Lippman, H. S.: A Comparative Study of Azure Granules Under Normal and Pathological Conditions, Thesis, University of Minnesota, 1920.

lymphoblastic leukemia) would tend to point to the theory that azure granulation is a functional product of secretion. Toren also believes that the formation of his "oral infection cell" is the result of "the entrance of irritating substance to the lymph glands," and that "it is extremely probable that we have a definite set of lymphatics principally involved in this irritation; namely, the submaxillary chain, since submaxillary drainage is common to so many parts of the tooth areas of the mouth."

A review of the work by Downey and Weidenreich[21] on the origin of lymphocytes shows that the mother tissue of all lymphocytes is reticulum, and that they may be formed all along the digestive system, in lymph nodes, hemolymph nodes, spleen, Peyer's patches, bronchi of the lungs, bone marrow, thymus, tonsils and adenoids and the appendix. Many of these lymphocytes, in turn, give rise to daughter cells, by mitosis. This shows that the production of lymphocytes is carried on in a great number of places in the body. If the blood cell described by Toren is a result of irritation from areas about the teeth on the mother tissue of the lymphocytes or lymphocytes themselves, it would be logical to assume that the irritation caused by the drainage from secondary foci, which are involved, with the same type of infection present in the primary areas, would give rise to a similar cell through any of these other sources of lymphocyte production, regardless of the location of the active process. This would eliminate the thought that these cells are specific for oral infection.

Walter believes that the cells described by Toren are irritated monocytes. It is true that, in some blood, one can find an occasional macrolymphocyte in which the nucleus has monocytic characteristics, but, as the slide is examined further, it will be noted that the monocytes present a different picture. Cases 12 and 22 have some of these cells. The arrangement of chromatin is looser and does not give the striped appearance to the nucleus that is found in the monocytes. The azure granules in the lymphocytes are larger and are not very numerous, while, in the monocytes, the cytoplasm is almost completely filled with a very fine, dustlike, azure granulation. An occasional monocyte will have azure granules that are fairly large, but the abundance of the finer granulation gives a ground glass appearance of a decided tint to the cytoplasm. The toxically altered monocytes in these same cases exhibit deep lobulations of the nuclei, an increased amount of coarser azure granulation and large vacuoles. Nucleoli are seen in some of the macrolymphocytes and leukocytoid macrolymphocytes. Monocytes with nucleoli are practically never seen in a stained blood smear.

Because no total leukocyte counts were made, the findings presented in the table of differential counts are relative, not absolute. The number of cells in each differential count in this series range from 250 to 500. In this small group of cases, the average polymorphonuclear count is low. The eosinophil count range from zero to the upper

21. Downey, Hal, and Weidenreich, F.: Ueber die Bildung der Lymphocyten in Lymphdrüsen und Milz, Arch. f. Mikr. Anat. 80: 306-395, 1912.

limits of normal, and this is also true for the mast cells. The lymphocytes are above the ordinary figures for normal, as is the average count for the monocytes.

This work is of a nature that demands a nicety of technic and interpretation, and necessitates careful study. The cases presented here are typical of those which are cared for by every dental practitioner, and while these cases are altogether too few, and the examination far too incomplete from the standpoint of the general physical condition, it will be only from an actual record of findings in a great many cases that conclusions can be reached regarding the practical value of a blood examination as an adjunct to oral diagnosis. Plans are being formulated for a more comprehensive treatment of this problem, in which close cooperation between medicine and dentistry will be maintained, in an effort to find one more means by which a more thorough understanding of this problem may be obtained.

SUMMARY

Studies on the structure of the blood cells were made of stained blood smears from twenty-five cases of apparently healthy individuals in which there was definite evidence of various types of dental infection. Six additional cases in which no evidence of dental infection could be found and having manifestations of systemic conditions were studied similarly; the latter acting as a check on the former.

It was found that:

1. The blood cells in some cases showed little or no change from blood that is accepted as normal.

2. The blood cells in other cases do show structural changes from blood that is accepted as normal.

3. The changes include an increase in azure granulation, increase in lobulation of the nuclei, increase in number of vacuoles, structural changes in the nuclei and variation in staining reaction of the cytoplasm.

4. The granulation in the cytoplasm of lymphocytes is azurophil and not eosinophil.

5. Toren's "oral infection cell" was not found, but there were some leukocytoid macrolymphocytes that, in many respects, resembled the cell described by him.

6. Such cells are not "irritated monocytes."

7. Leukocytoid mesolymphocytes, macrolymphocytes and leukocytoid macrolymphocytes are found in cases having no evidence of dental infection.

8. The presence of macrolymphocytes or leukocytoid macrolymphocytes is not constant in cases having dental infection.

9. The changes that were observed in these cases are not diagnostic for dental infection.

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NEWER KNOWLEDGE OF CALCIUM METABOLISM IN HEALTH AND DISEASE, WITH SPECIAL CONSIDERATION OF CALCIFICATION AND DECALCIFICATION PROCESSES, INCLUDING FOCAL INFECTION PHENOMENA*

By WESTON A. PRICE, D.D.S., M.S., F.A.C.D., Cleveland, Ohio

INTRODUCTION AND REVIEW

IN previous communications,[1] I have submitted evidence which I interpret to indicate that the difference in apparent tissue change about infected tooth roots is not necessarily an expression of difference in the quantity of infection but rather an expression of the type and extent of reaction on the part of the host; that decalcification with the production of a granuloma is a protective process, the granuloma being, in purpose and in effect, when functioning, a quarantine station placed by Nature between the infection and the host; that there may be, therefore, a condensing osteitis as the expression of a reaction rather than a rarefying osteitis, in which latter case there may be quite the opposite of a chamber about the infected tooth, and, further, that a zone of abnormally dense bone may surround a chamber of rarefaction and partially or quite completely hide it from view; that these qualities of reaction on the part of the patient are such that they may be divided into three groups on each of two bases: first, the type and nature of the local reaction, and, second, the presence or absence of a tendency to systemic involvement from focal infection and other so-called rheumatic group diseases in general.

I have demonstrated in the foregoing communications that one of the most important effects of focal infection is expressed in the blood changes, particularly the calcium of the blood; that the calcium of the blood is in different states, some of which is interpreted to be ionized because it is diffusible. Some associated with the thrombin in the circulating blood is released in the process of clotting, and a portion is easily available for chemical and physiologic reaction.

I have shown that the administration

*Read at a joint meeting of the sections on Oral Surgery, Exodontia and Anesthesia, and Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Sixty-Seventh Annual Session of the American Dental Association, Louisville, Ky., Sept. 24, 1925.

1. Price, W. A.: Dental Infections, Oral and Systemic (Vol. 1); Dental Infections and the Degenerative Diseases (Vol. 2), Cleveland, Penton Publishing Co., 1923; Dental Infections and Related Degenerative Diseases, Some Structural and Biochemical Factors, J.A.M.A., 84:254-259 (Jan. 24) 1925; Fundamentals Suggested by Recent Researches for Diagnosis, Prognosis, and Treatment of Dental Focal Infections, J.A.D.A., 12:641 June, 1925.

of cod-liver oil and calcium lactate, and particularly an activated cod-liver oil, has direct bearing and influence on the general symptoms and physical well-being and the reducing of susceptibility to dental caries.

The evidence presented also strongly indicated that the manner in which the body utilizes its calcium not only becomes a basis for classification of individuals into three particular groups, but also seems to have a direct bearing on the type of affections to which that individual will be susceptible or against which he will make a poor fight.

TABLE 1.—100 CONSECUTIVE FAMILIES*

	No. of Cases in Families	Rheumatic Group Affections					
		Severe		Mild		Absent	
		No.	%	No.	%	No.	%
Tuberculosis	51	6	12	7	14	38	75
Diabetes	15	1	7	3	20	11	73
Anemia	15	6	40	1	7	8	53
Stroke	72	8	11	25	35	39	54
Cancer	45	2	4	11	24	32	71

*Study of association of nonrheumatic group affections with presence or absence of rheumatic group susceptibilities.

This paper is not designed primarily further to support the evidence previously submitted, though I have much additional available evidence for doing so, but is designed to give a bird's-eye view of a new outlook on healing science in general, and dental and medical practice, and the prevention of dental caries in particular, in the light of the important new knowledge regarding the normal and abnormal uses, distribution and wastage of calcium.

That the calcium of the body is not only one of the most important and indispensable factors, but one of the most exacting and far-reaching in its influence on defense and susceptibility, is more and more abundantly demonstrated with the accumulation of new data. I have previously presented evidence indicating not only that the rheumatic group lesion susceptibilities are related to calcium metabolism and tend to be characterized by a lower than normal level of certain of its phases, but also that certain affections, such as diabetes, tuberculosis and cancer, show indications of a relationship to calcium in that they seem to be associated with certain high levels, as regards total calcium, as a characteristic of the individual before being broken by disease, this level characterizing the individuals who tend to decalcification in the presence of irritants; and that, apparently, it is not the levels of the calcium compounds, but chiefly the mechanisms that control these levels, with which we are concerned.

These studies have seemed to indicate that the calcification or decalcification of a lung tubercle would largely determine the progress of the affection, if not the fate of the individual. Similarly, it was shown that hyperglycemia tends to be associated with extensive peridental decalcifications, such as pyorrhea alveolaris, and that the infection of this disease tends to increase the hyperglycemia, and hence the necessity that diabetics be treated accordingly with regard to their predominant dental infections.

A further detailed study of this aspect of this problem has brought additional evidence which I am presenting in part in Tables 1 and 2. These show the results of careful tabulation on 100 consecutive families, where they have been studied with regard to the presence or absence in the family of tuberculosis, anemia, diabetes, stroke and cancer, in

order to determine the association of nonrheumatic group affections with the presence or absence of rheumatic group susceptibilities.

In these families, we study the individual, his or her brothers and sisters, the brothers and sisters of each parent, and the four grandparents, making, on an average, sixteen individuals per family. This, therefore, is a study of 1,600 individuals from this standpoint. As previously stated, records are discarded when the information is considered too incomplete to justify deductions.

TABLE 2.—STUDY OF ASSOCIATION OF NONRHEUMATIC GROUP AFFECTIONS WITH PRESENCE OR ABSENCE OF RHEUMATIC GROUP SUSCEPTIBILITIES (100 CONSECUTIVE FAMILIES)

	No. of Cases in Families	Rheumatic Group Affections			
		Severe		Mild or Absent	
		No.	%	No.	%
Cancer	45	2	*4*	43	*96*
Tuberculosis	51	6	*12*	45	*88*
Diabetes	15	1	7	14	*93*
Stroke	72	8	*11*	64	*89*
Anemia	15	6	*40*	9	*60*

We have divided these 100 individuals into three groups on the basis of my recent classification with regard to the rheumatic group affections; namely, severe, mild or absent susceptibility, and we find that when tuberculosis has appeared, in 75 per cent of the cases it has been in the group with absent susceptibility, as compared with 14 per cent mild, and 12 per cent severe; diabetes, 73 per cent in the absent group, 20 per cent mild, and 7 per cent severe; anemia, 53 per cent absent, 7 per cent mild, and 40 per cent severe; stroke, 54 per cent absent, 35 per cent mild, and 11 per cent severe; cancer, 71 per cent absent, 24 per cent mild, and 4 per cent severe. When we have been in doubt regarding classification, we have placed the individual in the more severe grouping of the two classifications in question.

If, now, we determine these percentages by combining the mild and absent groups into one, and compare these with the severe, we find that we have cancer, 96 per cent, as compared with 4 per cent; tuberculosis, 88 per cent, as compared with 12 per cent; diabetes, 93 per cent, as compared with 7 per cent; stroke, 89 per cent, as compared with 11 per cent, and anemia, 60 per cent, as compared with 40 per cent.

This seems strongly to emphasize again what I have brought out in my previous communications to the effect that, when cancer appears, it tends to be in a group of individuals with high defense for the rheumatic group diseases, people who quite routinely say either that they have never been sick a day in their life or have not had any rheumatic group disturbances; which, as I have repeatedly shown, is the group in which we find the high level of calcium.

It must not, however, be concluded or presumed that the matter is so simple as one of threshold or level of any calcium factor, total, active, diffusible, nondiffusible or otherwise. It is in all probability related not only to certain high levels but also to mechanisms of control of calcium levels, mechanisms which themselves become definitely disturbed, and regarding which we have apparently quite definite evidence.

It is of interest in this connection to quote from a communication that has

recently appeared[2] in which Dr. Ludwig M. Wolff, sanitary councillor and German cancer specialist and research worker, is reported, from Paris, to have discussed recent cancer etiology theories. The title of the article is "German Cancer Expert Denies Cancer Germ Theory." After stating why he feels justified in saying, "There is no such thing as a cancer germ. There can be none. How do I know that? Very simply," he goes on to outline how cancer appears only after thirty and forty years of age, while no organisms are known to be selective of age. His statement is so clearly to the point that the next three paragraphs are quoted directly from him.

> The last report of the Middlesex Hospital in London supports this view by recording the significant fact that cases of cancer there have been known to recover spontaneously. It is on this and similar facts that Prof. Barton Scammell, the president of the Radium Institute at Dover, England, bases his idea, for which there is a good deal to be said, that owing to certain defects in the diet and the preparation of modern food, the civilized human being of today suffers from lack of potassium in the body and that this is one of the factors, if not the main factor, in the occurrence of cancer. It is, of course, a well known fact that the primitive races do not suffer from cancer.
>
> The Dover idea of treatment involves the use of radio-phosphate of potash. This oxidizes the blood and prevents an excess of calcium, that usual phenomenon of middle age, just about the time when cancer begins to rear its head. The solutions of the radioactive alkali tend to clear out of the body the calcium accumulations.
>
> While the treatment and the avenue of research on which my own work and that of those with whom I am associated is based, starts from the same general conception as that of the Dover workers, we adopt somewhat different methods.

2. Science News-Letter, Vol. 7, No. 230, Sept. 5, 1925.

The line on which Dr. Wolff and his associates are working has to do chiefly with the roentgen ray and radium, both for treatment and prevention, and involves, as you will note, a conception of disturbance of the mechanisms of control of calcium. It is of more than ordinary interest that my researches from a clinical and blood chemical standpoint should have indicated the need for the same general point of view that these German and English workers have obtained from direct contact with the clinical and research aspect of the cancer problem.

RECENT ADVANCES

The space available for this communication does not permit of an abstract or review of the recent important communications bearing on calcium metabolism. A few are of such outstanding importance that I will refer to them both in this paragraph and later.

It has been known for years that the complete removal of the parathyroid glands of most animals, including human beings, will result in death preceded by tetany, and that this change is accompanied by a marked fall in blood calcium. Collip[3] has recently presented a method for extracting an active principle from parathyroid glands, with which he has been able to cure the tetany of parathyroidectomy and apparently return an animal to normal when it seemed to be dying from that condition.

Cameron[4] has done important work on the comparison of the total calcium

3. Collip, J. B.: J. Biol. Chem., 63:395 (March) 1925.

4. Cameron, A. T., and Moorhouse, V. H. K.: The Tetany of Parathyroid Deficiency and the Calcium of the Blood and Cerebrospinal Fluid, J. Biol. Chem., 63:687 (April) 1925.

of the blood and of spinal fluid in dogs, and has shown that in that animal, under the conditions of his experiments, the average of twenty-two determinations on 20 dogs gave 11.1 mg. total serum calcium and 5.8 total cerebrospinal fluid calcium, the latter averaging 53 per cent of the total calcium of the blood serum, with variations from 42 to 73.

Hess[5] has shown that, just as cod-liver oil will cure or prevent rickets, so cholesterol or phytosterol that has been exposed to irradiation will do so, while the nonirradiated products will not.

Steenbock[6] and his associates have shown that the exposure of the dry meal of a deficient diet, capable of producing a deficiency disturbance, will cure the deficiency if it is exposed to suitable irradiation.

Holt[7] has presented important evidence indicating that the ion product of calcium and phosphorus is more significant than is the product of inorganic phosphorus and total calcium.

OUTLINE OF TASKS UNDERTAKEN IN THESE STUDIES

Before outlining in detail the various determinations that have been made, I shall state briefly the objects to be sought. While our own and other studies have abundantly demonstrated both the importance of calcium in general, and particularly of the level of the active calcium, there are available no data adequately indicating the interrelationships between these, and their relative importance when disturbed. There has been much evidence that individuals may starve to death for calcium on a diet amply supplying it. We have therefore had no means of adequately interpreting the nature and rôle of activators.

While it has been abundantly demonstrated that the parathyroids largely control the total calcium of the blood, as evidenced by the death from tetany following the removal of the parathyroids, there has been practically no information as to the influence of the parathyroids on the active and diffusible calcium. The carrying on of investigations intended to determine the effect of parathyroid, which we have undertaken several times, has been entirely unsatisfactory, owing to the irregular results obtained, strongly indicating differences in efficiency of the experimental product. The influence of parathyroid extract and of activators has not been studied, or at least data are not available, demonstrating the rôle of these products in connection with deficiency diets or in connection with irradiation. I have had these various factors under intensive study during the past year.

THE ROLE OF PARATHYROID IN CALCIUM METABOLISM

The rôle of parathyroid in calcium metabolism, while known to be exceedingly important, has been but little understood. We have been continually embarrassed in our investigations on this problem during several years to find that we could not with any certainty duplicate our results. We readily discovered that the difference related to a variation in the product with which we were experimenting and that this lack

5. Hess, Alfred F., and Weinstock, Mildred: Antirachitic Value of Irradiated Cholesterol and Phytosterol, J. Biol Chem., 64:193 (May) 1925.

6. Steenbock, H., and Daniels, A. L.: J.A.M.A., 84:1093 (April 11) 1925.

7. Holt, L. Emmett, Jr.: Studies in Calcification. III. A Quantitative Study of the Equilibria Concerned with the Calcification of Bone, J. Biol. Chem. 64:579 (July) 1925.

of constancy obtained with practically all the available brands used.

With the announcement by Collip[3] of his success in concentrating an active principle from this gland by means of dilute hydrochloric acid, we began to use that method for making the extracts and again, three hours, six hours and twenty-four hours later. It will be noted that, in all of the products secured from drug stores, the level of the total blood calcium went progressively down; whereas, with the products that we prepared ourselves in each case, it

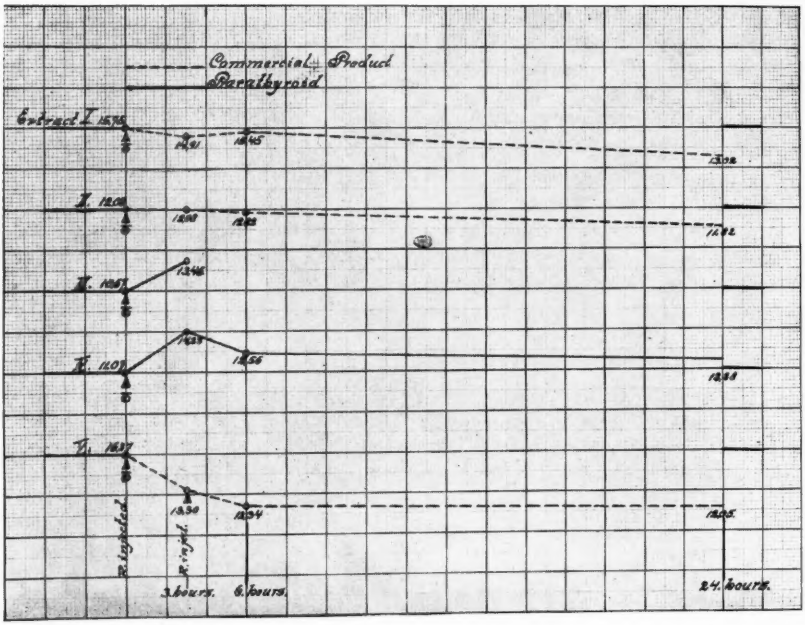

Fig. 1.—Variations between commercial products and those prepared in the author's laboratory. Dotted lines: commercial products. Solid line: laboratory products.

directly. Figure 1 indicates the difference between the commercial and our own products. In it, extracts Nos. I, II and V (shown by dotted lines) are from commercial products purchased at the drug stores; III and IV (shown by solid line) are products that we made ourselves.

In each case, one injection was made. The blood was taken before the injection and the total calcium determined, went up at three hours, dropped back part way at six hours, and in twenty-four hours was still above the normal level at which it started. It was, therefore, a continued and not a transient effect. The amount injected in each case was, as nearly as we could judge, the same.

That this result is not without exception is shown in Figure 2, a comparison of a commercial preparation

and our own preparation, in which it will be seen that, with the commercial preparation, two injections of 0.3 c.c. were used (Rabbit 1364). There was a slight increase from 11.34 to 11.6 in the total calcium and then a decline to from 11.29 to 13.1, or 16 per cent, then a drop to 11.58, still above the original (whereas, in this time, the commercial product came below the starting point) then, after the four injections, increased again to 12.45, an

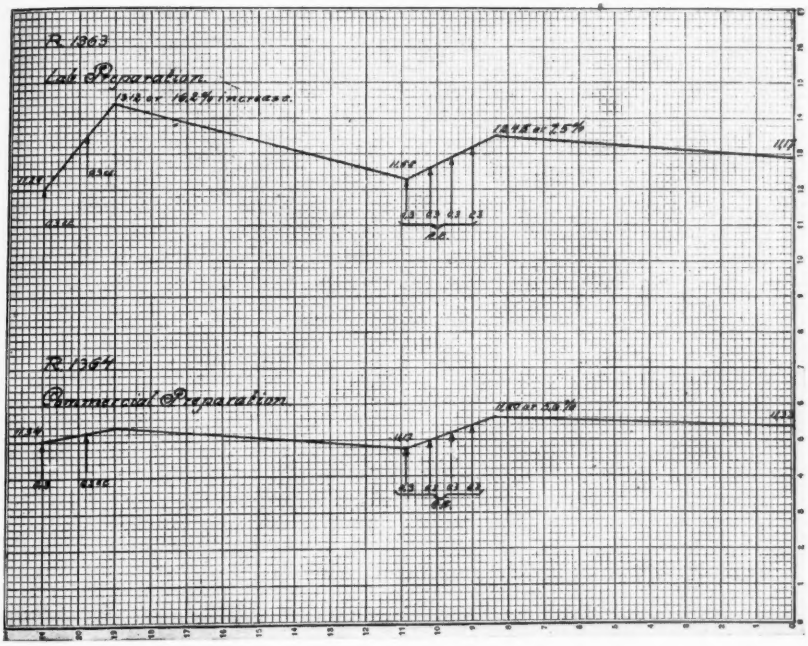

Fig. 2.—Comparison of commercial preparation and a preparation from the laboratory of the author.

11.17, a little below the starting point, when four more injections were given and the total calcium rose to 11.8, an increase of 5.6 per cent, or 4 per cent above the starting level, and in twenty-four hours decreased to 11.33, just a little below the starting point.

At the same time (in Rabbit 1363), the same injections were made with one of our laboratory preparations, and in the same period there was an increase of 7.5 per cent, and in twenty-four hours had come down to 11.1.

We have accordingly tried the effect of larger doses of parathyroid for comparison. Figure 3 shows results in two rabbits injected with fresh extract of parathyroid. The first (1362) received 0.2 c.c. of our preparation and in an hour a second injection of 0.2 c.c., with the effect that, in three hours, the total calcium had increased to 14.12

mg. from a starting point of 11.70, a total increase of 20 per cent. In three hours, this fell to 13.06 mg., and in twenty-four hours to 12.97, an amount still 11 per cent above the starting point.

Rabbit 1360 had a starting calcium of 11.51 mg. and received 2.5. c.c. at

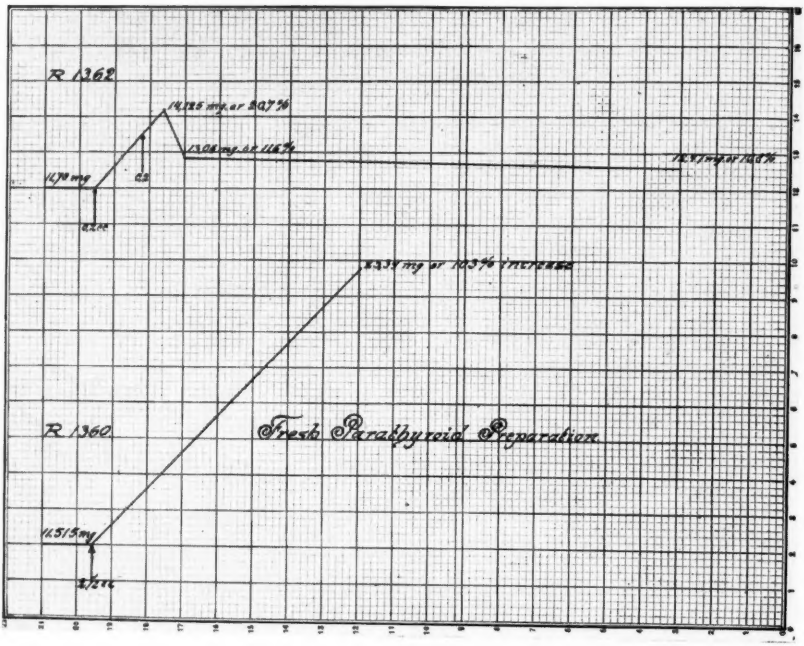

Fig. 3.—Results in two rabbits injected with fresh extract of parathyroid. In one, the total calcium doubled in six hours.

once, with the result that, in six hours, the calcium increased to 23.39 mg., a total increase of 103 per cent, soon after which the rabbit died.

This marked difference in the efficiency of the commercial and our own make of parathyroid extract is of such great importance that I gave the matter considerable study, going directly to the abattoir and ascertaining the nature of the products that were submitted by the slaughter houses, presumably for the purpose of making parathyroid products.

On being given material that was supposed to correspond with that supplied for the purpose of making the product, we made careful histologic sections, which indicated that a considerable part, amounting in some samples to as high as 50 per cent of the total gland material, consisted of other gland materials, including mucous, lymph, salivary and thyroid. It cannot easily be understood or appreciated what extreme difficulties are encountered in dissecting out these glands. The parathyroid glands in an ox are only about the size

of a small bean and are enclosed in a fibrous capsule, which is largely enmeshed in thyroid tissue. Each gland must, therefore, be dissected out with great difficulty, even if it is located, and its location is a particularly difficult procedure since so many other gland structures are encountered. The neck tissue in koshered animals is so mutilated that it is often impossible to locate these glands.

We have here two separate and important problems. One is the necessity for getting parathyroid product and the other is the necessity for not getting other gland product, which may have effects entirely different from those desired. Our studies in this matter will be reported later. We have enough facts to indicate that the effect of some of these other gland products is directly to depress the calcium, and they are accordingly antagonistic to parathyroid.

STUDY OF BLOOD TO DETERMINE THE CHANGES PRODUCED IN ITS CHEMICAL FACTORS BY THE PRESENCE OF FOCAL INFECTIONS, SUCH AS DENTAL INFECTION, WITH SPECIAL CONSIDERATION OF SPECIAL FORMS OF CALCIUM IN THE BLOOD

In previous communications, I have demonstrated important variations not only in total calcium of the blood, but also in a factor that we have, for want of better nomenclature, referred to as active or ionized. Normal circulating blood has, according to Vines, approximately from 10 to 11 mg. of total calcium, of which approximately 4 mg. will be combined with thrombin, and which is released in the process of clotting and will appear in the blood serum as an amount that will be active in the biologic test of producing normal clotting in a control serum in an amount approximately equivalent to that of the total calcium determined by incineration or colorimetric methods. In several reports by Vines, as in our own, it is demonstrated that a portion of the blood calcium does not appear as an active factor in certain pathologic states, and with removal of the pathologic state this factor tends to disappear. We have accordingly undertaken to study the factors that are influenced most, both by pathologic states and by medication.

As in the results of Collip, we have been able to raise the normal calcium of animals by injection of freshly made parathyroid extract, as indicated, for example, in Figure 3, in which it will be seen that the blood calcium has been more than doubled in a rabbit by intravenous injection in the short space of three hours, the actual increase being from 11.51 to 23.39 mg. It is of particular importance and interest to note that this increase in total calcium in this healthy rabbit of more than 100 per cent in three hours was not accompanied by an increase of the active calcium, which decreased slightly. This is of paramount importance as will be presently demonstrated.

While the knowledge of calcium metabolism has been enlarging rapidly, data have not been provided, to my knowledge, which establish the relation of the various factors, total, active, diffusible and nondiffusible, in each normal and pathologic state. This has seemed to be one of the paramount problems demanding solution before

proper progress can be made in interpreting the relative and actual importance of these various factors when made as single determinations. I have already reported large numbers of cases of tests on animals, both normal and pathologic, in which active and total calcium have been presented, though we did not, at that time, determine the diffusible and nondiffusible.

While several methods are available for making calcium phosphorus, fat and other determinations, the following have been used chiefly in these studies: total calcium by the Kramer-Tisdall method, and as modified by Tisdall, Clark, and Collip;[8] diffusible and nondiffusible calcium by the methods of Cushny, Cruickshank, Rona and Takahashi;[9] inorganic phosphorus by the method of Bell and Doisy;[10] active calcium by a combination of the methods of Vines, and that of West;[11] fat and lipoids by the method of Bloor.[12]

Table 3 presents, and Figure 4 illustrates, the important changes in these various factors which have been tested at the same time in two rabbits, whose normal health had been affected by placing an infected tooth beneath the skin. As will be noted from the weights, these animals were strong healthy stock; they had been in our pens for months, and they were fully accustomed to the environment and to the diet, which was not changed.

As previously reported, the effect of placing an infected tooth beneath the skin of an animal, such as a rabbit, is to start in progress a series of physical changes that are expressed in the blood picture as changes in blood cells and their proportions, particularly in the blood chemical constituents. It is practically a universal rule that animals so treated live or die within a few days or weeks in proportion as they have the ability to build about the involved tooth a fibrous encapsulation strongly resembling the dental granuloma and functioning, as I have shown, as a quarantine station. This protection may delay death for weeks or months, though, in time, these animals tend to break (even though they have encapsulated the tooth), with nephritis or pneumonia. As the active calcium goes down to or below 6, the animals become very lethargic, and death is usually a matter of only a few days or hours after the active calcium gets down to 5.5, since

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9. Cruickshank, E. W. H.: Studies in Experimental Tetany: I. Distribution of Calcium. II. Colloidal and Ionic Calcium, Brit. J. Exper. Path., 4:213 (Aug.) 1923; Cushny, A. R.: The Colloid-Free Filtrate of Serum, J. Physiol., 53:391 (May) 1920; Rona, P., and Takahashi, D.: Ueber das Verhalten des Calciums im serum und über den Gehalt der Blutkorperchen an Calcium, Biochem. Ztschr., 31:336, 1911.

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11. Vines, H. W. C.: J. Physiol., 55:86 (May) 1921. West, Fred; Bauer, J., and Barnickol, K.: A New Method for the Determination of Calcium and Thrombin in Serum, J.A.M.A., 78:1042 (April 8) 1922.

12. Bloor, W. R.: A Method for the Determination of Fat in Small Amounts of Blood, J. Biol. Chem., 17:377, 1914; A Method for the Determination of "Lecithin" in Small Amounts of Blood, ibid., 20:133, 1915.

TABLE 3.—CHANGES IN BLOOD CONSTITUENTS FROM PLACING AN INFECTED TOOTH BENEATH THE SKIN OF A RABBIT

	7th			11th	12th	14th	17th	22nd	33rd
									Day

TABLE 3.—CHANGES IN BLOOD CONSTITUENTS FROM PLACING AN INFECTED TOOTH BENEATH THE SKIN OF A RABBIT

Days Rabbit 1356	First Day*	5th Day	7th Day†	7th Day 6 hrs. later	8th Day	9th Day‡	11th Day	12th Day	14th Day**	17th Day	22nd Day	33rd Day
Total calcium (1)	13.96	12.57	12.21	14.42	13.41	10.67	9.57	9.38	10.97	9.81	10.18	15.39
Active calcium (2)	10.52	6.29	6.12	8.29	10.23	9.96	8.23	7.44	8.80	7.18	9.35	10.02
Inorganic phosphorus (3)	4.57	3.40	2.93	3.53	3.12	2.13	4.54	3.79	2.83	3.15	6.36	3.07
Nondiffusible calcium (4)	8.45	7.81	7.43	7.42	8.56	4.95	3.74	5.92	3.06	4.23	4.40	10.35
Diffusible calcium (5)	4.90	4.61	4.78	7.00	4.85	5.72	5.77	3.46	7.91	5.58	5.78	5.04
Total calcium balance (7)	+21.19	+2.74	−4.23	+10.90	+1.84	−17.27	+3.17	−5.29	−8.96	−9.10	+24.75	+7.25
Active calcium balance (8)	+8.08	−18.61	−22.07	−10.74	−8.08	−18.79	−2.64	−12.47	−15.10	−17.38	+18.47	−9.24
Weight (9) (grams)	2,233	2,269	2,319		2,242	2,272	2,229	2,276	2,267	2,345	2,345	2,229
Leukocyte count (10)	7,200	9,600	7,500			9,400	8,800	8,200	9,600	10,200	28,600	10,800

*Tooth implanted beneath the skin. †Parathyroid administered.
‡Cod-liver oil and calcium administered (Also ultraviolet ray, 30 minutes). **Ultraviolet ray for 30 minutes.

in that state they are rapidly overwhelmed.

This becomes, then, a simple and an efficient means for producing a pathologic state which is, as I have abundantly shown in my previous communications, comparable to that of patients suffering from chronic dental infections with regard to levels of calcium, ratio of polymorphonuclears to small lymphocytes and lassitude.

I have accordingly used rabbits prepared in this way on which to make determinations as to the effect of various procedures on calcium levels. These have included the use of parathyroid extract, the administration of calcium lactate and cod-liver oil, and irradiation with ultraviolet. Table 3 and Figure 4 present the data regarding Rabbit 1356. (We have the parallel data for another rabbit run at the same time, the report of which we have deleted because of the length of this paper.) These two rabbits each had a tooth planted beneath the skin. Rabbit 1356 started with a total calcium of 13.39, an active calcium of 10.52, a diffusible calcium of 4.9, a nondiffusible calcium of 8.45 and an inorganic phosphorus of 4.54. In four days, the total calcium had fallen to 12.57, or 6 per cent, the active calcium to 6.29 or 40 per cent (reduction), the diffusible calcium to 4.7, or 4 per cent, the nondiffusible calcium to 7.8, or 7.5 per cent, and the inorganic phosphorus to 3.4, or 24.5 per cent. For the next two days the active calcium and the diffusible calcium remained about constant, while the total calcium went down to 12.21 and the nondiffusible to 7.4, and the inorganic phosphorus to 2.93.

At this point, the animal was injected with parathyroid extract, 0.5 c.c.,

hourly, until three injections were given. Six hours after the first injection, the total calcium had increased to rose from 7.43 to 8.56; and the diffusible fell from 7.00 to 4.8, after a temporary rise, during the first eight

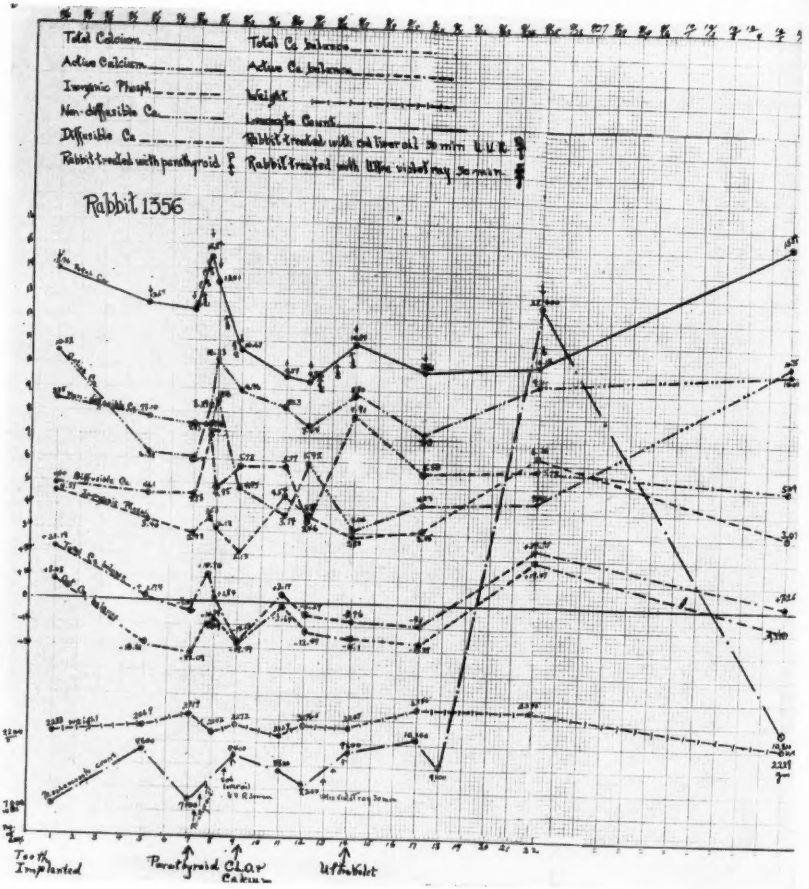


Fig. 4.—Changes in total and active and diffusible and nondiffusible calcium in a rabbit under the skin of which an infected tooth had been placed.

14.92 mg., an increase of 19 per cent, and in twelve hours, it dropped to 13.4 mg. The active calcium rose abruptly from 6.12 to 10.23, a remarkable increase; the nondiffusible hours, from 4.7. The inorganic phosphorus first rose from 2.9 to 3.5 and then dropped to 3.12.

It is of especial interest to note, first, that the administration of parathyroid

extract was able temporarily to snatch this rabbit from a crisis, such as regularly results from a depression of the active calcium to or near 5, and that not only was the total calcium raised but also all the other forms.

This immediately raises the question as to where this calcium came from, for it is not at all probable that it came from the food. Light is thrown on this by the change in the animal's weight, which fell 77 gm. The parathyroid extract apparently made it possible for the blood stream to take calcium from the natural depots, the skeleton, but simply changing the location of calcium would not change the total body weight. This phase is being investigated.

During the next twenty-four hours, the animal was twice given 5 gm. of calcium lactate and 5 gm. of activated cod-liver oil by stomach tube, with the combined effect in three days of checking the rapid decline of the inorganic phosphorus, which, while it dropped at first to 2.1, rose to its starting normal level of 4.57. The total calcium dropped at first more rapidly than the active, but the nondiffusible made a considerable reduction from 8.5 to 3.7, then rose to 5.9 on the fourth day, with the total calcium at 9.3 and the active at 7.4.

At this time, the rabbit was given three treatments with ultraviolet rays from an air-cooled quartz mercury vapor lamp. This was followed by a rise of the total calcium to 10.9, the active from 7.4 to 8.8, and the nondiffusible from 5.9 to 7.9, the diffusible going down, and the inorganic phosphorus down to 2.85.

As more and more evidence accumulates, it emphasizes the great importance of the calcium balance as an expression of defense. By one method of determining it, total calcium is multiplied by total inorganic phosphorus, which should give a product of 40 or above. The amount above 40 is spoken of as a positive calcium balance, and below 40 as a negative calcium balance.

In Table 3, the calcium balance on the basis of these two methods of determination is presented, and it will be noted that, on a basis of the total calcium, there was a positive balance of 21, and for the active calcium, a positive balance of +8 on the first day of the experiment. On the fourth day of the experiment, that is, four days after the tooth was planted, the total calcium balance had dropped to a +2 and the active calcium balance to a —18. The active calcium balance remained negative throughout the entire course until the twenty-first day of the experiment, when it rose to +19; whereas, the total calcium balance went to a negative of —17 on the eighth day and rose finally to +24 on the twenty-first day. These two curves are shown in Figure 4. The tooth was removed surgically, and the rabbit returned rapidly to normal.

INVESTIGATIONS OF THE NATURE AND SOURCE OF ACTIVATORS FOR CALCIUM METABOLISM

That human beings, animals and birds may die with calcium metabolism disturbances on diets adequate in calcium but deficient in other factors has been abundantly demonstrated. Prominent among the accessory factors is phosphorus, but even an ample supply of phosphorus and calcium will not completely relieve serious and often fatal results in the absence of certain other accessory food factors, among

which are chiefly fat-soluble substances. I have found no terminology which seems so well suited to the conditions involved as the term "activators," for, in our investigations on animals and human beings, they seem clearly to be of that nature. We surely cannot speak correctly of parathyroid hormone as an accessory food factor and yet parathyroid is distinctly an activator.

I have already referred to the work of Hess and his co-workers with relation to the rôle of cholesterol in serving as an activator after it has been exposed to irradiation, though inadequate without that exposure, and of the effect of exposing to ultraviolet radiation the dried cereals which produced the pathologic states and thereby curing the same affection which they have produced, as so clearly brought out by Steenbock.

The information as to the nature, type and method of action of these activators has been exceedingly meager, and I have undertaken an extended series of investigations to throw light on this point. Owing to the rapidity of growth and ease of handling large numbers, I have chosen white rats and chickens as most suitable for these particular studies.

The first group of chickens consisted of 150 white Plymouth Rocks. These were divided into twenty-five groups of six each. All had the same diet and conditions of housing, the diet being No. 3143 of McCollum, which is ample in calcium and low in phosphorus and activators. The temperature of the room was maintained at 95 F. for the first week and 90 F. the second week, in accordance with the best care of young chickens. Table 4 gives the data on this series.

The controls, which were given sunshine in connection with this diet, consisted of two lots, one of nine and the other of six chicks, the former exposed for six hours a day and the latter, three hours a day, to sunshine. There were no deaths in either group in the fourteen days of the experiment. All were lively and well feathered. These controls were put in the same darkened room for the balance of the time that they were not in the sunshine. All chicks had the same basic diet, and were kept in darkness and subjected to ruby light.

Group 2 had darkness and an hour of ruby lamp twice a day for feeding. All of these chicks died by the tenth day. Their death was preceded by marked weakness, particularly of the legs.

Group 3 had, in addition, thirty minutes daily exposure to ultraviolet light from a mercury quartz lamp. Three died. The three that lived were lively and well feathered. Feathering is much affected by some diets, and is not a measure of growth or "pep."

Group 4 were given ultraviolet irradiation through a special filter. Three died, and three lived, and were lively and well feathered.

Group 5 were subjected to the same conditions as Group 4, except that window glass intervened. All died. Weakness of the legs was one symptom shown.

Group 6 were given raw cod-liver oil. Four died. Three lived, but growth was retarded.

Group 7 were given 0.1 per cent cod-liver oil. All died.

Group 8 were given 0.1 per cent cod-liver oil, activated in the sunshine. Four died. The two that lived showed medium growth.

Group 9 were given cod-liver oil,

TABLE 4—NATURE AND EFFECT OF ACTIVATORS (SIX CHICKS IN EACH GROUP, ALL OF WHICH HAD THE SAME ADEQUATE DIET AND TEMPERATURE)

Lot No.	Variable Condition	Deaths During Days of Experiment														No. Dead	No. Living	Lot No.	Condition
		1	2	3	4	5	6	7	8	9	10	11	12	13	14				
1	Controls															0	9	1	Peppy; well feathered
2	Darkness and ruby lamp				1	2		1		1	1					6	0	2	All dead; weak legs
3	Same as 2 plus ultraviolet daily for 30 min.			1				2								3	3	3	Peppy; well feathered
4	Same as 3 plus blue filter			2						1						3	3	4	Peppy; well feathered
5	Same as 3 plus heavy window glass					3	2	1								6	0	5	All dead; weak legs
6	Same as 2 plus CLO 1%					2	1		1							4	2	6	Retarded growth
7	Same as 6 but 0.1%		1		1	2		1		1						6	0	7	All dead; weak legs
8	Activated CLO sunshine; 0.1%		1			2							1			4	2	8	Medium growth
9	Same as 8 but 1%			2			2								1	5	1	9	Medium growth
10	CLO activated 15 min.; 0.1%				1	1	2									4	2	10	Medium growth
11	Same as 10 but 1%		1				1	1								3	3	11	Peppy; medium growth
12	CLO activated 6 hr. sunshine; 0.1%						1		1							2	4	12	Peppy; well feathered
13	Same as 12 but 1%								1							1	5	13	Peppy; well feathered
14	Same as 12 but 5%		1	2		2							1			6	0	14	All dead
15	CLO activated ultraviolet 3 hr.; 0.1%		1	2			1									4	2	15	Retarded growth
16	Same as 15 but 1%			1	1		2	1								5	1	16	Retarded growth
17	Same as 15 but 5%							1								1	5	17	Peppy; well feathered
18	Raw cod liver oil 5%				1	3	1									5	1	18	Well feathered; moderate pep
19	CLO activated sun 30 minutes; rubbed on neck						1	2								3	3	19	Peppy; delayed feathering
20	Same as 19; raw cod liver oil					1	2							1		4	2	20	Delayed growth; poor pep
21	Cholesterol activated ultraviolet, 1%						1					1		1		3	3	21	Medium feathered; peppy
22	Same as 21 not activated. 1%				1		4		1							6	0	22	All dead
23	1% parathyroid extract				1											1	5	23	Medium feathered; fair pep
24	Food exposed to ultraviolet daily			2	1	1										4	2	24	Delayed growth
25	Exposed 3 hr. daily to sunshine															0	6	25	Peppy; well feathered

activated in sunshine. Five died, and one lived. Growth was medium.

Group 10 were given 0.1 per cent cod-liver oil activated in sunshine for fifteen minutes. Four died, and the two that lived showed medium growth.

Group 11 were given 0.1 per cent cod-liver oil activated in sunshine for fifteen minutes.

Group 12 were given 0.1 per cent cod-liver oil, activated for six hours in sunshine. Two died, and the four that lived were lively and well feathered.

Group 13 were given the same treatment as Group 12, but with 1 per cent cod liver oil. One died and the five that lived were lively and well feathered.

Group 14 were given the same treatment as Group 12, but with 5 per cent cod-liver oil. Six died.

Group 15 were given 0.1 per cent cod-liver oil activated in ultraviolet light for three hours. Four died, and the two that lived showed retarded growth.

Group 16 were given the same treatment as Group 15, but with 0.1 per cent cod-liver oil. Five died, and in the one living, growth was retarded.

Group 17 were given the same treatment as Group 15, but with 1 per cent cod-liver oil. One died. Five lived and were lively and well feathered.

Group 18 were given cod-liver oil, 5 per cent. Five died. One lived and was well feathered and moderately lively.

Group 19 were given cod-liver oil activated in sunshine for thirty minutes the oil being rubbed on the neck. Three lived and were lively but feathering was delayed.

Group 20 were given the same treatment as Group 19, but with raw cod-liver oil. Four died, and the two that lived showed delayed growth and little spirit.

Group 21 were given 1 per cent cholesterol, activated by ultraviolet rays. Three died. The three that lived were moderately well feathered and lively.

Group 22 were given the same treatment as Group 21, but the cod-liver oil was not activated. All died.

Group 23 were given 1 per cent parathyroid extract. One died and the five that lived were moderately well feathered and fairly lively.

Group 24 were given food exposed to ultraviolet rays daily for thirty minutes. Four died, and the two that lived showed delayed growth.

No. 25 was the other control referred to at first.

Blood chemical determinations were made on these various groups, with special consideration for calcium, total and active, and inorganic phosphorus.

It will readily be seen, from the data herewith presented, that these chickens were very largely dependent on the various forms of activation, employing ultraviolet rays, raw and activated cod-liver oil, and raw and activated cholesterol, and that the raw cod-liver oil had a quite different effect from that activated for fifteen minutes, and that activated a short time as compared with that activated for a long time. The products did not save the chickens if exposed to either sunshine or ultraviolet overlong, but, on the contrary, hastened their death. All the chicks receiving an overactivated product in all the groups died. This is particularly important because of the harm that will be done by ignorance in undertaking to activate preparations for practical use. I will refer to this in further detail later.

In order further to check these problems, a second group of 100 chicks was divided into five groups. Group 1, controls, received the sunshine again; Group 2, ruby light; Group 3, ruby light and raw cod-liver oil; Group 4, ruby light and activated cod-liver oil; Group 5, ruby light and ultraviolet rays. As in the previous series, the chicks were kept in a room from which all light was excluded except from a ruby lamp, which was left burning night and day. This was a much brighter ruby light than the one in the preceding experiment.

Several facts are of interest: The highest percentage of gain in weight occurred in the group receiving the ultraviolet radiation. The total calcium was higher in the two groups receiving cod-liver oil, one raw and the other activated, and also in the group exposed to ultraviolet irradiation, than in the controls, for part of which there were two groups. The active calcium was higher in the controls receiving sunshine than in any of those receiving treatment. The diffusible calcium was lowest in the group receiving the raw cod-liver oil. The most striking difference was in the nondiffusible or colloidal form, probably as calcium proteinate, the group receiving the raw cod-liver oil being much the highest. The organic phosphorus of the whole blood was highest in the group receiving the raw cod-liver oil. This is of importance. The product of the total calcium and inorganic phosphorus was highest in the group with the raw cod-liver oil and the ultraviolet irradiation. The product of the active calcium and inorganic phosphorus was highest in the group with the raw cod-liver oil. Table 5 gives these data, from which it will readily be seen that many factors are involved other than simply the administration of calcium, cod-liver oil or ultraviolet rays. I therefore carried through another series (Table 6), in which 250 chicks were used, being divided into twenty-six groups, and in which it was undertaken to establish more definitely the changes produced in the various levels of the calcium in its various forms in the blood.

TABLE 5.—EXPERIMENTAL DATA

	% Gain	Calcium							Phosphorus							Ca×P			
										W'le Blood		Plasma		Cell					
		Total	Active	Diffusible	% Diffusible	Non-diffusible	% Non-diffusible		In. Phosph. P	Org. Phosph. P	Org. Phosph. PO_4	Org. Phosph. P	Org. Phosph. PO_4	Org. Phosph. P	Org. Phosph. PO_4	Total Calcium × In. P.	Act. Ca. × In. P	Diff. Ca. × In. P.	Ca++ + −Log Product (×PO_4)$_2$ Ph = 7.35
Controls	520 193.2	8.61 10 92	6.08	6.35 4.94	73 70 54 75	2.26 5.97	26.30 45.25		3.24	78.0	250	18.7	60.0	1,155	370	27.89	19.69	20.57	24.38
Ruby light	256.9	10.37	5.18	5.99	57.70	4.38	42.30		3.31	71.3	228	10.8	37.8	1,015	325	34.32	17.14	19.82	24.10
Ruby light + raw cod liver oil	165.3	13.59	5.60	3.92	28.80	9.67	71.20		5.0	78.0	250	18.7	60.0	1,155	370	67.95	28.00	19.60	23.41
Ruby light and act. cod liver oil	226.9	13.41	5.60	5.31	39.50	8.10	60.50		2.87	106.0	340	18.7	60.0	125	400	38.48	16.07	15.23	23.90
Ruby light + ultra violet ray	266.9	14.79	5.25	6.18	41.70	8.61	58.30		3.05	60.2	192	17.36	55.6	1,215	389	45.10	16.01	18.84	23.73
		Diet 3143																	

It should be noted in passing, in order that some slight idea may be had of the prodigious task of making chemical analyses of so many animals, that it takes several hours to make these various determinations on a single bird or animal, and exceeding care has to be taken with every step of the procedure.

Table 6 gives the results of the blood chemical studies on the third set, consisting of 250 chickens. The percentage of gain of the controls was 63.8 per cent in the period involved. It is of interest to note that several of the groups outdistanced the controls in gain.

The average total calcium for the controls was 9.96; active calcium, 8.14; inorganic phosphorus, 4.52. Of those under treatment, several had a distinctly higher total calcium in the blood than did the controls. Again, 5 per cent cod-liver oil activated in the sun for fifteen minutes is high in calcium, this group having a total calcium of 13.13. Ten per cent cod-liver oil activated for fifteen minutes in the sun gave a total calcium, 10.07; 10 per cent cod-liver oil activated for one hour in the sun, 11.43; 1 per cent cod-liver oil activated for twenty-four hours in the sun, 11.37; raw cod-liver oil rubbed on the necks, 11.26; activated cod-liver oil (thirty minutes in the sun), rubbed on the necks, 15.04; 5 per cent cholesterol, activated for thirty minutes, 10.2, in contrast with 5 per cent cholesterol, not activated, 9.3.

The active calcium, which in the controls averaged 8.14, was 10.02 in the group receiving 5 per cent cod-liver oil activated for fifteen minutes in the sun and 10.2 in the group receiving 10 per cent cod-liver oil activated in the sun. The cod-liver oil activated for thirty minutes in the sun, rubbed on the necks, gave an active calcium of 10.2. We have here, then, distinct evidence of the influence of the oil activated in the sun.

The inorganic phosphorus also gives important information. For the controls, it was 4.52; for the group receiving 5 per cent raw cod-liver oil added to the food (Diet No. 2966, Steenbock and Nelson) it was 5.26; for the 5 per cent cholesterol activated for thirty minutes in the sun, 4.77; 5 per cent cholesterol not activated, 2.24; 5 per cent cod-liver oil activated for fifteen minutes in the sun, 2.93, distinctly lower than the 5 per cent raw in this group.

Another item of great importance has developed in this research. Several of the chickens that were having cod-liver oil rubbed on the neck, in each group given raw and activated oil, developed large cystic sacs filled with a serous fluid. This fluid was aspirated, pooled together for each group, and from Group 20 had the remarkably high level of 18.97 for total calcium, and 14.19 for active, and from the group of chickens with the activated cod-liver oil, 27.14 per cent for total calcium and 18.09 for active.

We seem here to have evidence that the application of activated cod-liver oil or even raw to the surface has a local action that is very distinct, and it is significant in this connection that the calcium of the blood of the group that had the activated cod-liver oil rubbed on the necks was 15.04 as compared with 9.96 for the controls. This point is being given further study.

There are many factors which are both intentionally and unintentionally varied and thereby modify the results.

One of these has been the intensity and source of the ultraviolet ray. Another has been the source of the cod-liver oil. For these reasons, the results of two different sets of investigations should not be expected to check. There is also an important difference in the stock, for we cannot always get the kind of chicks we desire.

Table 6.—Experimental Data

	Chicks Diet 2966	Calcium			In. Phosphorus	Ca×P
		% Gain	Total	Active		Total Ca × In. Phos.
1	Controls Sunshine	63.80	9.96	8.14	4.52	45.00
2	Ruby light	154.70	10.28	8.30	4.83	49.65
3	U. Vi. R. 20 min. daily	111.60	9.25	8.30	4.10	37.92
4	U. Vi. R. 2 hr. daily	95.70	8.53	8.13	4.10	34.97
5	1% raw C. L. oil	176.60	9.73	6.60	6.33	61.59
6	5% raw C. L. oil	57.70	8.95	8.33	5.26	47.19
7	10% raw C. L. oil	74.30	9.45	8.13	2.90	27.40
8	1% C. L. oil 15 min. sun.	69.20	10.90	8.82	3.17	34.55
9	5% C. L. oil 15 min. sun.	78.03	13.13	10.02	2.93	38.48
10	10% C. L. oil 15 min. sun.	55.05	10.07	10.22	2.10	22.48
11	1% C. L. oil 1 hr. sun.	85.20	20.21		2.22	46.82
12	5% C. L. oil 1 hr. sun.	77.30	9.66	7.64	3.90	37.67
13	10% C. L. oil 1 hr. sun.	70.60	11.43	8.32	2.77	31.62
14	1% C. L. oil 24 hr. sun.	72.90	11.37	8.66	3.71	42.18
15	5% C. L. oil 24 hr. sun.	76.60	10.25	8.52	3.62	37.20
16	10% C. L. oil 24 hr. sun.	67.20	9.72	8.82	3.51	34.10
17	1% C. L. oil 24 hr. U. Vi.	133.10	10.84	5.84	5.45	59.07
18	5% C. L. oil 24 hr. U. Vi.	89.04	10.96	6.60	4.85	53.16
19	10% C. L. oil 24 hr. U. Vi.	36.80	10.42	8.32	1.94	20.20
20	Raw C. L. oil on necks	6.30	11.26			
20	Fluid from necks of 20		18.97	14.19		
21	C. L. oil 30 min. on necks	56.07	15.04	10.22	2.15	32.35
21	Fluid from neck 21		27.14	18.09		
22	5% raw cholesterol	1.40	9.35	8.92	2.24	20.91
23	5% cholest. 30 min. sun.	26.10	10.25		4.77	48.90
24	10% raw butter	62.20	11.69	7.25	5.40	63.13
25	10% butter 24 hrs. U. V.	50.80	8.95	6.75	5.20	46.54

Results in More than 1,100 Blood Chemistry Studies of Patients

The purpose of this investigation has been to determine the systemic expressions that obtain as chemical changes in the blood as the result of focal infections, particularly dental infections. The procedure includes some or all of the following: a microscopic study of

the blood cells, differential count, hemoglobin, color index, Arneth index, Walker index, calcium in different forms, alkalinity index, blood sugar, inorganic phosphorus, total organic phosphates, plasma phosphates, blood cell phosphates, nonprotein nitrogen, total proteins, total albumin, total globulin, euglobulins a, b and c, calcium—inorganic phosphorus product—the product of the calcium ions and phosphate ions, with other factors in special cases. A large percentage of the patients have pathologic states as a reason for the examination. A considerable number are approximately normal.

I am presenting herewith typical cases representing three distinct groups: the first, those with a high total calcium, accompanied by a high active calcium; the second, a high total calcium, accompanied by a low active calcium; and the third group, a low total calcium and low active calcium. These groups are presented in Tables 7-9.

It is of special interest to note that those individuals in Group I, Table 7, are largely individuals who would be classified as having an absent susceptibility, on the basis of classification previously presented by me, for the rheumatic group affections. Group II is made up largely of individuals who would be grouped on the basis of rheumatic susceptibility as having acquired susceptibility; and Group III is made up largely of individuals who would be in the classification I have previously given of inherited susceptibility.

Several factors are of exceeding importance. In the clinical study of these individuals, we are continually finding a predominance of decalcification in the presence of apical and gingival irritation in Group I, the group with high calcium. In previous papers, I have stressed the apparent significance of this quality of decalcification in the presence of an irritant in its relation to the poor fight that the people of this class make in case of a serious tuberculous infection. The same type of dental infection, such as a putrescent pulp, will, with this group, produce large periapical areas, usually readily disclosed in radiograms; whereas, a similar typical dental infection produces a very different local tissue change and radiographic appearance because of the tendency to a condensing osteitis about the rarefying, which hides or obstructs the view of the zone of rarefaction.

By referring to Table 7, it will be noted that Group I, with high total and high active calcium, are well above the averages that are usually published for total calcium. It will also be noted that, on the the basis of both total and active calcium, the calcium balance is either positive or but slightly negative. It will also be noted that the polymorphonuclears, except in the first two cases, are high in proportion to the small lymphocytes. Except for the first two individuals, these patients have been conspicuously free from disturbances of the rheumatic group. The inorganic phosphorus, in all the cases of this group except the first one, will be noted to be above 3.

In an analysis of the cases in Group 2, Table 8, those with a high total and low active calcium, it is interesting to note the prevalence of disturbances of the nervous system. In our experience, a marked difference, exceeding 1 mg., between active and total calcium is suggestive, and, if more than 2 mg., distinctly abnormal. Further, individuals

with an active calcium below 9 are practically always in a state of reduced vitality and energy, frequently referred to by the patients as lassitude or lack of pep. Six of the thirteen individuals in this group have an inorganic phosphorus below 3, and nine of the thirteen show a negative active calcium balance of more than 10. My interpretation of the suggestiveness of the blood pictures of the individuals in this group would be that they are practically all suffering from overloads, an important factor of which may be dental. When they return to normal, the blood pictures will be much more like those of the preceding group, Group 1.

An analysis of Group 3, Table 9, indicates a low total calcium and a low active calcium as characteristic throughout, and frequently associated with low inorganic phosphorus. Seven of the thirteen have an inorganic phosphorus below 3 and three below 2. A striking feature is the quite general negative calcium balance of both total and active calcium. When a calcium balance is in negative phase more than 10 points, for children it is interpreted to be suggestive, if not diagnostically significant, of rickets. In adults, when the developmental processes are completed, it takes quite different expressions. I would expect the people of this group

TABLE 7.—CALCIUM METABOLISM (GROUP 1) *High* TOTAL. *High* ACTIVE.

Case	Alkalinity Index	Total Calcium	Active Calcium	Inorganic Phos.	Total Organic Phos.	Total Ca Balance	Active Ca Balance	Sugar	N. P. Nitrogen	Cholesterol	Total Fats	Fatty Acids	% Polymorphonuclears	% Small Lymphocytes
1346 MrKn	33.8	11.42	10.32	2.3	58.5	−13.0	−15.6	105	31	143	951	808	51.2	41.1
1545 MrHs	33.0	12.13	11.62	3.9		+ 8.2	+ 6.2	100	27				52.5	37.0
1549 MsNh	32.4	11.42	10.96	3.1		− 4.6	− 6 1	132	25				70.6	21.5
1560 MrWn	30.5	11.44	10.20	3.2		− 2.9	− 6.9	122	56				63.8	28.4
1565 MrFr	29.1	13.12	11.05	3.8		+10.0	+ 2.5	131	18				79.0	13.8
1569 DrMy	41.3	12.54	10.57	3.1		− 0.9	− 7.1	97	34				60.5	29.0
1572 MrBn	39.0	11.33	11.00	3.1		− 4.4	− 5.5	86	22	114	474	360	66.0	33.2
1575 MrRh	34.2	11.28	10.06	3.6		+ 1.4	− 3.1	102	27	129	464	335	65.0	26.6
1612 MrHn	31.0	12.70	10.06	3.1	36.7	− 0.4	− 8.6	105	34	190	746	554	65.3	20.0
1620 MrGs	35.4	12.55	10.52	3.2	31.4	+ 0.9	− 5.8	98	27	124	900	775	65.4	25.9
1624 J.Kn	38.0	11.62	10.18	3.5	39.5	+ 1.5	− 3.6	101	26	134	470	236	63.0	28.5

to be dragging considerably and with many serious breaks.

I shall refer to the individuals in these various tables again as I discuss

PHOTOGRAPHIC PLATE EFFECTS *

These various investigations have strongly emphasized not only the important part played by calcium in various physiologic processes, particularly as a factor in immunity and defensive capacity of the organism, but also the necessity that, in addition to a source of calcium for the needs of the body, there should be a source of activator. The nature of these activators is understood only in a very general way and their

TABLE 8.—CALCIUM METABOLISM (GROUP 2; *High* TOTAL; *Low* ACTIVE)

Case	Alkalinity Index	Total Calcium	Active Calcium	Inorganic Phos.	Total Organic Phos.	Total Ca Balance	Active Ca Balance	Sugar	N. P. Nitrogen	Cholesterol	Total Fats	Fatty Acids	% Polymorphonuclears	% Small Lymphocytes
798 MrCy	34.4	11.20	8.80	2.2	58.0	−15.0	−20.2	97	29	89	713	624		
1268 MrGn	32.4	11.36	9.78	3.4		− 0.6	− 6.1	500	67	448	878	430	61.2	26.4
1414 MsKn	39.5	11.06	9.87	2.8	52.0	− 8.0	−11.5	125	34	98	1025	912	55.0	37.0
1484 MsMe	37.0	10.37	8.27	3.5		− 3.0	− 9.7	107	22	72	662	590	68.8	26.6
1573 MrHk	36.7	11.05	9.46	4.1	37.2	+ 5.1	− 0.6	81	30	111	800	689	55.8	29.4
1580 MrKr	28.6	11.43	8.70	4.2	39.1	+18.1	− 3.4	109	33	84	320	236	58.6	33.0
1583 MrHs	28.5	10.60	9.08	5.1	57.3	+14.6	+ 0.6	93	35	175	509	334	48.3	45.4
1585 MrLe	30.1	11.41	8.80	2.0	34.4	−16.9	−22.2	127	31	89	833	744	53.0	41.0
1586 MrDy	32.1	11.73	9.24	2.3	33.1	−12.6	−18.5	138	32	111	463	352	61.8	30.8
1617 DrDt	34.5	11.12	9.02	1.9	13.6	−18.7	−22.7	104	27	128	696	565	68.3	24.0
1619 MrBr	34.0	11.58	9.42	1.3	33.2	−26.7	−27.3	149	28	128	600	472	65.6	27.9
1621 DrSy	39.5	10.42	8.49	3.3	31.8	− 5.6	−12.0	108	22	258	740	488	60.2	31.4
1623 ChMn	34.7	12.53	8.17	3.3	33.2	+ 2.1	−12.5	107	22	93	687	584	64.1	26.2
1623 ChMn	36.4	11.12	9.17	2.6	51.1	−10.9	−16.0	98	26				60.0	30.0

the matter of treatment, for many of them, particularly in the third group, can be helped a great deal by systemic treatment for the raising of their calcium in addition to the removal of dental infections, where such exist, together with the removal of all possible overloads, including other infections.

methods of action is but slightly comprehended.

This particular aspect of this investigation has been carried on to determine fifteen to twenty minutes, and then injected into the circulation of the animal, there is an elevation of the active calcium within an hour or two which,

TABLE 9.—CALCIUM METABOLISM (GROUP 3; *Low* TOTAL: *Low* ACTIVE)

Case	Alkalinity Index	Total Calcium	Active Calcium	Inorganic Phos.	Total Organic Phos.	Total Ca Balance	Active Ca Balance	Sugar	N. P. Nitrogen	Cholesterol	Total Fats	Fatty Acids	% Polymorphonuclears	% Small Lymphocytes
492 MsEn	37.1	9.57	8.28	1.8	28.5	−22.1	−24.6	116	33	129	733	604	64.2	26.6
589 MrBn	39.0	9.66	9.30	1.8	29.3	−22.4	−23.0	98	28	85	710	624	50.0	42.5
945 MrHk	33.4	9.73	8.52	3.5		− 4.3	− 9.6	92	40	148	1090	842	63.7	28.6
1124 MsMr	35.9	9.27	8.85	3.7		− 5.3	− 6.9	105	38				50.0	41.4
1522 MsBr	38.1	8.81	8.78	3.8		− 6.0	− 6.1	67	26				71.0	19.9
1553 MrFr	37 1	9.51	9.23	2.3		−17.8	−18.5	98	26				76.3	12.8
1554 MrJn	38.2	9.69	8.84	3.1		− 9.1	−11.9	100	27				68.6	24.4
1561 MsKs	33.6	9.81	8.92	2.6		−13.9	−16.2	108	28				51.0	39.3
1589 MrFr	31.0	10.13	8.92	1.9	32.5	−20.0	−22.4	125	27	89	600	511	50.0	40.0
1601 MrSd	41.3	10.09	8.79	2.4	58.6	−15.4	−18.6	84	26	112	752	640	50.7	32.2
1622 MsMs	42.3	9.83	8.96	2.6		−14.1	−16.4	115	39				67.7	25.1
1624 J.Kn	38.5	8.58	8.78	3.8		− 7.0	− 6.2	112	26				70.6	19.5
1625 MsSp	36.9	9.84	8.80	3.4	144.2	− 6.4	−10.0	102	37	111	281	179	58.2	32.4

somewhat of the nature of the action of the activators. In previous communications, I have reported,[13] in connection with the important rôle of calcium, the significant fact that, if the blood serum of an animal whose calcium is low, particularly the active calcium, shall be exposed to ultraviolet radiation for from in the presence of the continued drain on the system, tends again to decline within twenty-four hours.

I have further demonstrated that this blood serum will make an impression on a suitably sensitive photographic plate, and, further, that such photographic plate reaction is changed by the exposure of that blood serum through

13. Footnote 1, last reference.

the action of the ultraviolet ray, and that an overexposure of the blood serum causes the active calcium to decrease instead of increase.

For three years, I have been studying intensively the phenomena involved in this reaction, and also those involved in the exposure of cod-liver oil to the ultraviolet ray, and the fact that this substance makes a strong impression on a photographic plate, largely in proportion to the type and extent of the irradiation with the ultraviolet ray. This has been demonstrated at length in my lectures during the last three years.

I wish, at this time, to present a quantity of new data which throw a vast new light on the mechanism of this whole process. That cod-liver oil will impress a photographic plate is so easily and strikingly demonstrated that anyone may readily reproduce the evidence. The simple placing of a photographic plate over a dish containing the cod-liver oil, without an intervening protection, will produce fogging in proportion to both time and temperature. It is therefore exceedingly easy to produce a very active preparation.

Figure 5 shows a series of exposures produced as follows: 1 is cod-liver oil, raw and unexposed; 2, a similar quantity of the same oil that had been exposed to sunshine for five minutes; 3, oil exposed to sunshine for ten minutes; and, similarly, 4, 5 and 6, thirty, forty and sixty minutes. It will be noted that the blackening of the plate has been progressive, as shown in the illustration reversed as a positive, directly in proportion with the time of exposure to irradiation. This is a specimen of Newfoundland cod-liver oil. The right hand series of this same figure shows the same results with another excellent oil.

Kindly have in mind the relation of this radiant energy to the ultraviolet irradiation which stimulates it. I have made an extensive study to ascertain, if possible, the nature and type of this energy, a part of which data will be presented herewith, and, because of the length of this paper, a part will be made a separate communication.

When cod-liver oil, whether irradiated or not, is placed in a refrigerator with a photographic plate over it, the effect is entirely different from that which obtains if it is placed in an incubator. Figure 6 shows two specimens made with the same oil. These differences of temperature constituted the difference in causative factors.

The science of radiotherapy, which is so rapidly developing, is calling for many applications which are not as yet built upon an adequate experimental basis.

I have previously presented evidence[1] (Vol. I, chap. 27) illustrating that ultraviolet irradiation, when administered to both healthy and diseased rabbits, produces at first a rise in the number of leukocytes, or positive phase, which is always followed by a more or less severe and more or less prolonged negative phase, the latter of which may more than offset in its depression the stimulation of the positive phase, provided the dosage has not been adequately measured and administered.

I have also shown previously, in this paper, that the chicks in Series I, which received cod-liver oil that had been exposed to ultraviolet radiation for too long a time, died, and that the same thing happened with too extended radiation to sunshine. Similarly, the evi-

dence brought out in the second series of chicks illustrates the importance of the dosage of the irradiation.

In Series 3, we have fed chicks on butter that had been exposed to ultraviolet rays for twenty-four hours. It has been shown by others that an extract of the toxic material from butter, injury that would be occasioned from exposing food overlong to ultraviolet light, whether from the sun or from an artificial generator, because of the production of substances distinctly deleterious to health. I have learned much from experimenting on myself, and one of the early safeguards that came from

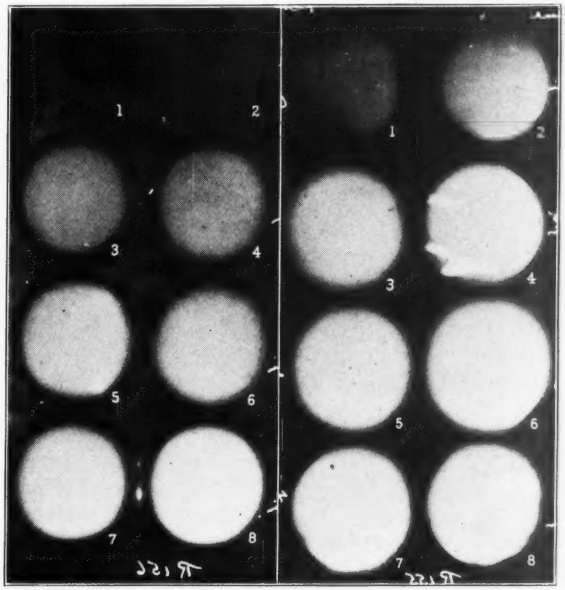


Fig. 5.—Series of exposures of panchromatic plate film which was placed over (left) Newfoundland cod liver oil and (right) Squibb's cod liver oil, which had been exposed to the ultraviolet ray for various intervals. The film was left over the oil for sixteen hours, and then developed for five minutes. *1*, oil not exposed to the ultraviolet ray; *2*, exposed to ray for five minutes; *3*, for ten minutes; *4*, fifteen minutes; *5*, twenty minutes; *6*, thirty minutes; *7*, forty minutes; *8*, sixty minutes.

placed on bread, killed mice in eight days, where the controls lived fifty days and died then for want of a growth promoting activator.

In this connection, it is important to raise a note of warning for those who would advise or in any way be responsible for the abuse and possible serious that source was secured as the result of severe headaches produced by taking cod-liver oil that had been exposed to ultraviolet rays from a mercury quartz vapor lamp for one half hour, even though the dosage was only a few drops.

Other important changes than these which take place in the cod-liver oil

when it is exposed to sunshine, thereby enabling it to produce fogging effects, are those changes which are produced in various organic and inorganic substances and in organ extracts as the result of irradiation. I have studied in this way most of the glands of internal secretion.

It has been known for some time that, when exposed to light, certain resins, oils, varnishes, paints, etc., give off hydrogen dioxid in sufficient quantity to blacken a photographic plate, a quality which they retain for a long time. We have demonstrated that this

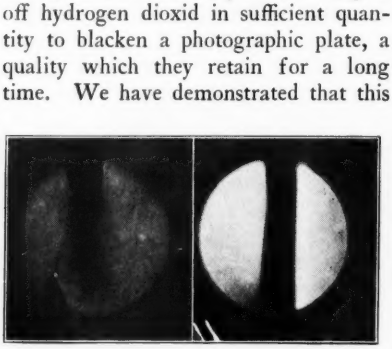


Fig. 6.—Exposure on panchromatic film of cod liver oil, not exposed to the ultraviolet ray. Left: Oil kept in ice box. Right: Oil kept in incubator.

is what takes place with cod-liver oil by placing it in a vacuum, in which condition it ceases to produce this effect, the water vapor, of course, being extracted with reduced pressure. These substances will not produce these effects in the absence of water vapor. It is also possible to transfer the effect to other substances; for example, if the tissue containing this material is put in a box and then the material is removed, the box will continue, for a period, to produce some of the effect.

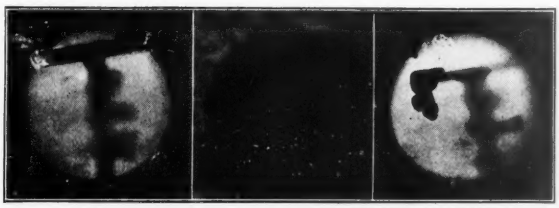
That it is not radiant energy is also demonstrated by the following experiment of putting a photographic plate over a dish containing the material and sliding it to a new position every five minutes. The effect is progressive with time, in accordance with the accumulation of the hydrogen dioxid in the water vapor of the air contained. I have also made very extensive studies with very sensitive electroscopes and have not been able to establish the presence of an energy carrying a charge.

The various kinds of radiant energy do not all carry charges, and, for this reason, we should distinguish between true photochemical effects, which are due to radiant energy producing chemical action, and photographic effects, which may be due to a gas reacting on a photographic plate. We are accordingly concerned here not with a radiant energy that is given off from blood serum, cod-liver oil, or organ and tissue extracts, but with a chemical reaction which takes place through space or some intervening fluids. These chemical compounds, which react on a photographic plate, are changed not only in quantity but also in quality, as judged by their different effects as the result of exposing the medium in question to radiant energy of different types.

We have quite different effects with many compounds whether the radiant energy comes from the sun or a quartz lamp. The substances, therefore, show evidence of difference in reaction to different lengths of rays. For example, Figure 7 shows the difference in effect in studying desiccated total pancreas. *A* shows the photographic reaction in the presence of an obstructing guide of the raw material; *B*, the same exposed to ultraviolet rays for thirty minutes; and *C*, the same exposed to sunlight for one hour. The marked difference between the effect of sunlight and of ultraviolet light may be noted. Limit of space

requires that this phase of this problem must be made the subject of a more extended individual report.

Typical illustrations will be found in such as the following: Solutions of various gland substances have been exposed to ultraviolet radiation from a mercury vapor lamp and to sunshine, in comparison with the same product without exposure. That there is much significance in the fact that these various organ substances produce fogging reaction even at a distance from the plate has been demonstrated by such means as the experiment previously reported of placing back in the circulation the blood serum that had been irradiated and noting its direct effect on calcium of the blood. It is a most interesting phenomenon that various organ substances do not behave similarly in effect on a photographic plate.



A B C

Fig. 7.—*A*, panchromatic film placed over desiccated total pancreas, 5 per cent, in physiologic sodium chlorid solution, which had not been exposed to the ultraviolet ray. The film was exposed for sixteen hours and developed for two minutes. *B*, film exposed as in *A*, but after the pancreas in solution had been exposed to the ultraviolet ray for thirty minutes. *C*, film exposed as in *A*, after the pancreas in solution had been exposed to sunlight for one hour.

Before referring further to these results, it should be noted that there is to be taken into consideration the change that is produced in a photographic plate, particularly a sensitive panchromatic plate, when all or part of it is exposed to water vapor for a period of time before its development. If, for example, an exposed plate is placed over a small dish of water for an hour or a few hours, the fogging will be reduced at that point which is directly over the water. If the plate has not been fogged and is similarly placed over a dish of water for one or several hours and then developed, it will be found that the plate is lighter in color where it was over the vessel of water than in the area surrounding the vessel. I have not been able to find an explanation of the physical chemistry involved. However, this is not the effect that is to be observed in the following illustrations, though evidence of it will often be an accompaniment.

When a photographic plate is placed over a vessel of water so that the water vapor comes in contact with it for an hour or two, and that surface is then put in contact with a piece of glass on which writing has been made with a wax pencil, and left in contact for five minutes, there will be a further whitening where the wax letters came in contact, as shown in Figure 8. When with the same procedure a solution of

certain organ substances is used instead of water, instead of there being a further whitening of the plate where it comes in contact with the wax lettering, there is a strong darkening of the plate, as shown in *B*, Figure 8.

When cod-liver oil that had been exposed to radiation is shaken with a solution of one of the gland products, say suprarenal, and each is in contact with the other by this emulsification for a short period, it is then separated by centrifuging, and then photographic plates are exposed to them and to other portions of these substances, which did

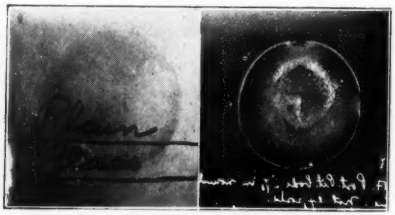


Fig. 8.—Left: Panchromatic plate placed over distilled water for sixteen hours, and developed for five minutes. Plain glass with wax writing was placed against the film side of the plate for five minutes before development. Right: Panchromatic plate placed over a solution of posterior pituitary body (not exposed) for sixteen hours, and developed for two minutes. Writing from another was transferred by contact for about five minutes before development. Note reversal.

not have this contact each with the other, it will be noted that there is a reduction in the activity of both the cod-liver oil and the gland product. It will also be noted that the plate fogging reaction of cod-liver oil on the one hand and of the various gland products on the other are entirely different in their nature. In certain cases, there is much evidence of a quite opposite type of action.

When cod-liver oil which is activated is brought in contact with calcium lactate, there is a rapid neutralizing of its fogging effect, as in Figure 9, which shows progressively the effect of increasing the proportion of calcium.

When blood is used as the test material, there is a distinct difference in the effect on the plate whether the blood has been oxalated, citrated, defibrinated or clotted, and in each of these conditions, blood reacts differently when exposed to the ultraviolet radiation from the sun, and still differently when exposed to the ultraviolet radiation from a mercury quartz vapor lamp.

When this blood has been allowed to stand for twenty-four hours, that part which has been oxalated makes a most striking reaction on a photographic plate, while of the other three preparations of blood, only the citrated blood exposed to ultraviolet continues to do so.

One cannot refrain from associating these various phenomena with the clinical effect that is produced in our animals as the result of medication with irradiated products and with results on our patients who have been suitably treated with calcium activators. May it not be possible that we have an approach here to the mystery of the hormones, whose illusive method of action and interaction has so completely eluded investigation; and, further, do we not here get a suggestion as to the nature of bacterial toxins and also to enzyme action? For some, this is a fancy; for others, there will be associated with these data a realization of a great systemic change that has come about in their own bodies as the result of stabilizing and improving their calcium metabolism through the proper

selection and usage of calcium associated with a suitable activator. There is much evidence, which the space available for this paper does not permit a review of, that a negative calcium balance is one of the fundamental, if not the most important, factors involved in dental caries.

TREATMENT AND PROCEDURE

This brings us to a consideration of the treatment of pathologic states that

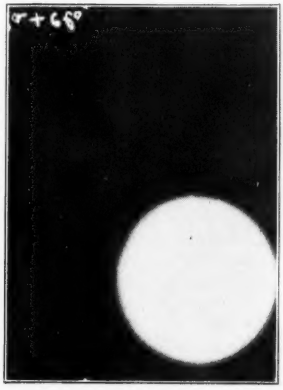


Fig. 9.—Above: Panchromatic plate placed over 50 per cent cod liver oil, exposed to the ultraviolet ray for thirty minutes, and 50 per cent calcium lactate. The plate was allowed to remain for sixteen hours, and then developed for five minutes. Below: Plate cod liver oil alone exposed to the ultraviolet ray for thirty minutes.

are related to calcium metabolism disturbances. In cases of pregnancy in various stages of advancement, we will see that the individuals have a markedly depressed calcium. This is not a universal accompaniment though the exceptions are few in the later stages of this physiologic process. The expectant mother has not only the continued demands of her own system, which will require approximately 0.6 gm. of calcium per day, but, in addition, now has the even greater demand of the new being which is developing, so that there is need for a greatly increased calcium in available form.

There are probably not only thousands but even millions of expectant mothers in the world who are not capable of readily paying this double bill, and, accordingly, Nature proceeds to borrow from the storehouses of the maternal body; namely, the teeth and bones.

If one will observe a herd of dairy cattle that is being intensively drained of its milk throughout the summer, it will be noted that, with the long-continued draft, particularly if the pasture has been poor, there is a settling of the rump bones so that the tail does not drop straight nor the pelvic bones maintain the square configuration of the rump. During the period of lactation, these animals have been borrowing from the storehouses of calcium to furnish it to the milk. They have been largely in negative calcium balance, and during the winter, when they do not have the stress of lactation and have an abundance of good fodder, they will more or less completely pay back this calcium borrowed from the bones.

Few of the tragedies of Nature have been more unrelenting and death dealing than has this overdraft on motherhood. I think no experience of my life has been more gratifying than to see how simple and easy it is to pay this bill for the expectant mother by the simple administration of calcium in a suitable form and quantity and an activator in suitable form and quantity.

The dosage for both calcium and activator is largely indicated by the

chemical analysis of the blood, though one cannot be far amiss in a routine program on a minimum basis. Extreme conditions will not only justify but also demand a more comprehensive program.

This is similarly true of the caries of childhood; for these individuals, on chemical analysis of the blood, prove to be also in negative calcium balance and are in need of virtually the same type of treatment.

The addition to diet that I recommended for negative calcium balance in general is as follows: from 1 to 1½ 5-grain tablets of calcium lactate taken with each meal, and with it a 00 capsule containing approximately 10 drops of cod-liver oil of good grade, which has been exposed to the sunshine for from one to fifteen minutes in order to activate it—one minute on bright summer days, to fifteen minutes on dull winter days. During this exposure, it should be in a shallow dish, preferably not more than an eighth inch in depth, and should be stirred meanwhile. Or raw cod-liver oil, 20 drops in a capsule, may be given.

Too much emphasis cannot be placed on the urgent necessity that the mistake shall not be made of putting this in the hands of indifferent or careless persons who will not watch the time carefully. Exposure for one hour to the noonday summer sun or to a mercury vapor quartz lamp produces a product which is distinctly harmful, and it would be better to use the raw cod-liver oil unactivated than to use this product. Different types of calcium disturbance require different treatments. Space does not here permit of further discussion. I will discuss this whole problem in a much more detailed manner, in an extended communication and in other papers.[14]

14. Price, W. A.: Some Systemic Expressions of Dental Infections, Ann. Clin. Med., 4 (May) 1926; Relation of Light to Life and Health, Ind. and Eng. Chem., 18:679 (July) 1926; Calcium Metabolism Studies. (a) Raising of Serum Calcium by Tropical Applications of Raw and Activated Cod Liver Oil. (b) Calcium Metabolism Disturbances, Associated with the Active Dental Caries of Childhood and Pregnancy, Am. J. Dis. Child., 32 (Nov.) 1926.

8926 Euclid Avenue.

THE ALLUREMENT OF SPECIALIZATION*

By ABRAM HOFFMAN, D.D.S., F.A.C.D., Buffalo, New York

THIS presentation, "The Allurement of Specialization" is prompted by the rapidly increasing number of specialties in the healing arts and the still more rapidly increasing number of specialists. The subject suggests three principal thoughts. (*a*) Are all these special lines of endeavor justified? (*b*) What is it that attracts one to these special lines? (*c*) Are those taking up the special lines properly qualified for such practice?

At the present time, it is quite generally conceded that dentistry is part and parcel of the great healing art and should be studied and practiced as such. The day of the purely "artisan" dentist is passing, and the time is not far distant when the dentist must, from necessity, have a broader medical training coupled with his handicraft, especially so if he elects to practice one of the specialties involving mechanical procedures wherein the biologic, chemical, physiologic or pathologic principles predominate or even play an important part.

It is impossible, mentally and physically, for the dentist to have a complete working knowledge of all branches of dentistry; neither can he give, in full measure, the variety and quality of service that is demanded in this age. The public is willing to pay for superior service, and the dentist must be prepared to give a commensurate service. The relationship of dentistry to general health is assuming such a commanding position that no part of the science can be neglected nor underestimated.

The specialist has come to stay. The superior service rendered by those who early devoted themselves to the various branches of the healing arts has been accepted in such a manner that, from necessity, the former "unit," medicine, has been divided and subdivided in accord with the demand for service. More recently, dentistry, which for many years was frowned on as a specialty of medicine, is also breaking up into numerous specialties, the first distinct and recognized branch being orthodontia. It is to this specialty that the substance of this paper is directed.

Assuming that specialization is justified and that there is a place in the dental field for the six or eight "odontias" that have developed within our midst, what is it that attracts one to give up a general practice and enter on limited practice?

This question has been asked of a half dozen or more well known specialists, and the following phrases seem to epitomize their opinions:

Interest in a special field and the desire to do the best possible work in that field.

*Read before the Section on Orthodontia and Periodontia at the Sixty-Seventh Annual Session of the American Dental Association, Louisville, Ky., Sept. 24, 1925.

Realization that concentration in one field will yield the best results.

A desire to get better fees.

A desire to advance the sum total of knowledge in dentistry.

A realization of the need by many individuals, for services of a specialist.

The alluring advertisements of appliance manufacturers.

The belief that specialization offers a field of "easier work."

A feeling that one's desires, training, equipment, clientele, etc., cannot at the same time lend themselves to a successful general practice and the conduct of a special line.

A desire to serve.

Without a doubt, men have entered the field of specialization with the highest ideals, but it may be said with just as much assurance that too many take up their work with a lack of the real sincerity and purpose which should surround a professional man.

There seems to be some peculiar fascination about being classed as a specialist, and this is undoubtedly an allurement which draws many inadequately prepared persons into the special field, to say nothing of the magnetic power of the supposedly large fees.

It is commonly asserted that far too many men are led into the field of orthodontia because of the alluring advertisements of the appliance manufacturer and the inference that this specialty offers an easy road to success. But what an awakening follows!—the blasted hope and shattered pride of the pseudo-orthodontist who has tried to break into the fold via the crude ready-made appliance or even by the "efficient, precision" apparatus, which is supposed to be the last word in its class. A few dismal failures, perhaps some irreparable damage, and someone is the target for severe criticism. It isn't the pseudo-orthodontist alone; for the science and art of orthodontia come in for a good share as well.

It is to be regretted that these misleading advertisements are allowed in our professional periodicals. Perhaps, we cannot avoid them in all of our journals, but we *can* cause their exclusion from our *own* journals, and, along with this, we can make an earnest plea for better censorship or their exclusion from the trade journals.

Assuming that there is a definite demand for the specialist, and recognizing from the rapidly increasing number of specialists that there is an ample attraction for individuals to take up the special lines of practice, what should be the basis upon which one might properly declare himself to the public as being entitled to the confidence, the emoluments and the other rewards which are usually accorded the specialist?

Many of them offer pitfalls of the most serious nature to the uninitiated. There is no short-cut nor easy road to success by the specialization route.

I make no plea for exclusion, exclusiveness nor anything of the sort in the practice of orthodontia. I have long been an advocate of the general practitioners' carrying on this type of practice so that the vast number of children in need of the service may have relief. But I do make an earnest plea for a more conscientious study before undertaking treatment.

The Century Dictionary defines a specialist as "a person who devotes himself to a particular branch of a profession, science, or art; one who has a special knowledge of some particular subject." Stedman's Medical Dictionary says that he is "one who devotes himself to the study of a particular

science or to the study and treatment of a particular group of diseases." Taken in the abstract, it appears that most specialists are "within the law," but is it not a fact that far too many are first declaring themselves specialists and then devoting themselves to acquiring the special knowledge and skill that their clientele has a right to expect? It is too frequently a case of "the cart before the horse."

I am not unmindful of the fact that there are many men in the specialties today who entered on their work in this very manner, but they have paid the price. The possessor of a dental degree has every legal right to follow any of our specialties. Has he a moral right to do so without adequate preparation? The helplessness of our patients and the absolute confidence with which they place themselves in our care make a righteous demand for the best service we have in us, and anything short of this is a breach of professionalism. The motive of the specialist should, first of all, be service, and until a man acquires this point of view, he is not entitled to the rewards of the highest idealism in professional life.

At the present time, when dental educational standards are undergoing so many changes, and with a condition bordering on chaos, it is almost like carrying coals to New Castle to add any fuel to the fire. Still, we are all working for the honor and advancement of a noble profession, which less than 100 years ago was refused admission to the realm of medicine; but because of the wisdom and foresight of such men as Hayden and Harris, and the persistence of the strong men who have carried on the early ideals, we now enjoy the privilege of being in a highly regarded profession, which must, and will, in the near future, be on the same plane as the recognized specialties of general medicine; for dentistry is just as properly a form of health service as any specialty of medicine and particularly those having a connection with the oral structures. Therefore, it behooves us to carry on, building better and better, as did those who have gone before us.

It seems almost satirical for one who has had no specific training as a specialist, other than twenty and more years of experience in orthodontia to offer suggestions as to the qualifications for one's announcing himself as a specialist. Perhaps that very status justifies one in taking the initiative.

It is quite generally admitted that undergraduate orthodontic instruction in the dental school has fallen short of the ideals of those in charge. This may have been due to the mode of teaching. Undergraduate instruction in a specialty should, at its best, only serve to stimulate to further effort and study after graduation. A somewhat liberal experience in teaching this subject convinced me of two things: first, that the average dental student has but little interest in orthodontics, and, secondly, that as some orthodontic instruction must be given, the course should be divided into two parts, a required and an elective course. All students should take the required or lecture course (including technics), and those few, for the percentage is small, who desire a further knowledge should be given the elective course, with proper credit for carrying on simple cases and witnessing the demonstration treatment of the more complicated cases in the clinic. This at once relieves the teacher of all students disinterested in the practical work, but at the same time gives the student all the necessary basic

instruction which should properly be included in the curriculum and which may rightfully be expected from the school.

I feel that until something more definite is offered, the prospective specialist should, on graduation, serve at least a three-year preceptorship in the office of an orthodontist whose practice is of such proportions as to enable study, investigation and treatment by the beginner. Under proper conditions and tutelage, this should afford a better preparation for specialization than the short postgraduate courses now being offered.

The short postgraduate courses that have been in vogue for the past twenty-five years have served their purpose well. Students and instructors have been carefully chosen, and the instruction has been a sincere effort to prepare the students for specialization; and thus they have helped to supply the constantly increasing demand for orthodontists. Many of the graduates of these schools properly occupy positions of prominence in our profession, and, again, many of them have used the schools solely as a stepping stone. The former are the ones who have had an inherent desire for advancement and service; the latter have had a false conception of the science and art with an "allurement" that is not conducive to the highest type of professionalism.

I shall not attempt to discuss at any length the evolutionary or revolutionary changes now taking place in dental educational circles. It remains a fact that much of the teaching is passé, and I believe that after the smoke has cleared away, all instruction, undergraduate and postgraduate, will be where it properly belongs—in the university dental schools. Such a plan will eliminate much superfluous study and loss of time. It will further result in systematic, graded instruction, so that a student, on graduation, may proclaim to the public, by his collegiate degree, what his position or status in the profession is or should be.

Several of our universities are already establishing graduate courses with a suitable degree on completion of the course. This is assuredly a step in the right direction.

It has long been my belief that one entering on a specialty should precede such a step with several years' experience in general practice. This undoubtedly has been a proper precaution in the past, but such loss of time may be just as properly avoided with the instruction that will result from coordinated teaching throughout the predental, dental and postgraduate courses.

The sincerity with which the leaders in the dental profession are working lends wholesome confidence in the future of our profession, and it should be a great comfort and satisfaction to feel that the American Dental Association, through its committees on education, the Dental Educational Council of America and the American Association of Dental Schools, will undoubtedly soon arrive at a standard of preparation which will qualify men for specialization. With such betterment, dentistry will be placed upon a still higher plane in the healing arts and in public esteem.

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DISCUSSION

Albert W. Crosby, New Haven, Conn.: I shall confine myself to a discussion of the question: "Are those taking up the special lines properly qualified for such practice?" "I am convinced that one of the pressing necessities of our times is a generation of dabblers to correct astigmatism and sterility

of the specialists," comments Glenn Frank.[1] "There is, of course," he continues, "the more accurate word 'polymath' which means a person of much varied learning, one acquainted with various subjects of study." As an illustration of such virility, he hopes we may "recapture the spirit of Leonardo da Vinci in twentieth century education, politics, and business. Leonardo da Vinci was the apostle of all-round expresson rather than specialized expression. He was a sculptor, an artist, a poet, an epigrammatist, an engineer, a statesman, a soldier, and a musician. Truly enough, he was not equally successful in an objective or critical sense in all these fields; but quite as certainly he owed his surpassing excellence in one or two of them to the fact that he tried them all." In our own times, the late F. Hopkinson Smith is an example of broad attainments. He had an enviable reputation as an artist, author, and engineer. Please do not think I am advocating the training of a man to be a Jack-of-all-trades; rather, I am speaking in the sense which John Hays Hammond used when asked what would he have him study whom he wished to educate for engineering. He said, "Anything but engineering." A specialty should be built like a pyramid—the broader the base, the higher the apex. The reason dentistry today is not quite on the level of medicine is because the younger science has not yet been able to furnish as many men of culture and education as has the medical profession. I differ from Dr. Hoffman in that I am strongly in favor of a professional man taking up general practice for a term of years before he limits his practice to a specialty. A specialty should be an evolution of experience. Professor Kellar of Yale cites an instance to the point:[2] An eminent nerve specialist who became such by a natural process of development out of general practice, once remarked that if he had his way every doctor should begin by engaging for a while in unspecialized activities. He enforced the contention by an incident out of his experience. A brilliant young specialist had struggled in vain with what he had diagnosed as a case of nerves and had finally called in the older colleague. The patient was a boy about 12 years old. The veteran listened to the pros and cons that were vexing the specialist, and without comment told the boy to take off his shirt. "There was as pretty a line of nodules around that child's sternum as you would ever see," he reminisced, "absolutely unmistakable. Don't you know what is the matter with him," I asked. "No, I don't." "Well, it's rickets" said I. "See those lumps?" "Yes, but what of it?" he asked. "Well," said I, "I guess you have never been in general practice, have you? If you had, those same lumps would be shouting rickets at you." And the old doctor went on to tell how often a narrow specialist could be fooled when an old fashioned family doctor would at once recognize the handiwork of one of his familiar foes. The man who told the story was no enemy of the specialist and specialization. He was himself a specialist. He was merely an advocate of breadth. As we turn the pages of the dental journals, we find them filled with advertisements of schools and so-called colleges which advertise to fit a man for a specialty in a few weeks or at most a year, with possibly a supplemental postgraduate course. It means the admission of battalions of ill-qualified men to positions of responsibility. They remind one of Aristotle's definition of a sophist—"One who makes money out of the appearance of knowledge without the reality." Their graduates come forth to fleece the public, arrayed in a wardrobe of disguises, if not wolves in sheep's clothing, to their own ultimate dissatisfaction. It is not the quickness of our arriving, but, as Goethe says, the quality of our striving. The perfection of fine fruit depends somewhat on the duration of its growth.

Charles R. Jackson, Indianapolis, Ind.: If Dr. Hoffman had chosen as his subject, "The Illusions of Specialization," discussion would have been much simplified. Personally, I am almost twenty years from its allurement and about twenty minutes from some of its illusions. In the practice of dentistry, today, there is no question about the need for *some* specialists. Just how many divisions there should be, only time and experience will de-

1. Frank, Glenn: Cult of the Dabblers, Century Magazine, January, 1923.

2. Kellar, A. G.: General Practice, Yale Rev., October, 1923.

termine, but the opinion seems to be growing that there are too many varieties of specialists in the limited field covered by the science of dentistry. Whatever may have been the actuating motives inducing these men to specialize, it would be interesting to get their opinions after five or more years of practice. Whether these newer specialties are to continue will depend on the experience of those now specializing. The specialty of orthodontia is long past this experimental stage and is firmly established as a necessity. Better facilities should be provided for dentists wishing to specialize in this branch. While we realize that dental teaching is now in the evolutionary stage, the plain statement of a few facts may, I believe, clarify rather than muddle the situation. Undergraduate orthodontic instruction, as carried on today, is woefully deficient and discouraging. This, combined with the natural indifference of the average dental student to things orthodontic, produces graduate dentists whose knowledge of orthodontics is practically nil. The really serious part is that the majority do not know that they do not know. Ignorance is only dangerous when we are not conscious of our ignorance. At one time, I believed the general practitioner could and should correct malocclusions, but experience has taught me that, without more instruction and experience than that attained in undergraduate institutions, it is exceedingly rare that one is found who doesn't do more harm than good. Yet we cannot blame the general practitioner. Our present teaching does not qualify a dentist in orthodontics but still leaves the impression in his mind that he is qualified. He has a diploma, the possession of which implies, at least, that he is competent to do all kinds of dental work. Dr. Bunkum assures him through advertisements that "straightening teeth" is simple—just put on an appliance, watch it work and collect a big fee. The result is a triple reaction—against the patient, the dentist and the practice of orthodontia. I believe that undergraduate instruction should be much better or much worse. It should be thorough enough to qualify the dentist to treat malocclusions intelligently or should be limited to didactic instruction so he will realize his deficiencies and not undertake cases without study and preparation. In our postgraduate schools, we need not so much quantity production as quality production. A few weeks instruction, however intensive, is not sufficient to turn out properly qualified specialists. It is to be regretted that any school should stoop to misrepresentation to induce patronage. A circular letter recently issued contained the following: "We assure you that towns with a population of 10,000 with adjacent communities are providing ample sources for very flattering orthodontic practices, and where there is room for one there is room for another." Such a statement is so manifestly absurd as to need no comment. However, we have high hopes for the quality of our future specialists. When our university schools have perfected plans for postgraduate work covering a considerable period of time we may then be proud of the recruits to our ranks. I am sorry to say that, in my opinion, the great influx of specialists at the present time is the result of the allurement of the almighty dollar and that there is a great awakening in store for the majority of them. There seems to be a very erroneous idea of the work, responsibilities and rewards of the orthodontic specialist at least. After all, the general practitioner is the important member of the dental family, and the only allurement of the specialties, in the final analysis, is the satisfaction gained from doing something in which one is particularly interested or for which one has a special aptitude.

Frederick S. Stillwell, Cincinnati, Ohio: Orthodontia is the most exacting science dentistry can offer. I believe that many young men are drawn to this specialty by erroneous ideas as to large fees and are not shown the actual relation to time spent and money received. What can be done? As I see it, it is partly the fault of the colleges. They give too much training in mechanics; and the conception of the mechanism of the mouth and the development or possibilities for lack of development are not presented as they should be. I believe every general practitioner should consult frequently concerning children in his care with an orthodontist, and leave the question of correction entirely to the latter's judgment. Is it not reasonable to assume that one who is a specialist and highly developed in one art is in a position to give better judgment and service than one who must keep up a semblance of technic in many branches? If we can get the general prac-

titioner to shift the responsibility entirely onto the orthodontist as to early or delayed treatment, we have done a great deal.

H. F. Hoffman, Denver, Colo.: We can never get away from the allurements of orthodontia, but what we must do, unless these allurements are to be the death of our specialty, is to devise some means by which the practitioner of a specialty, especially orthodontia, shall be required to keep himself prepared for the advance of his profession. Our specialty occupies a unique position. We have no legal requirements except being licensed for the practice of dentistry, and we have absolutely no orthodontic educational standard of qualifications. Just before I left home, a representative of the department of community organization of our state university said to me: "We are considering seriously a movement to require periodical reexamination of professional men," referring especially in his conversation to physicians and dentists. Teachers, as he said, are now required in most states to keep abreast of the advancement of their profession. This, it seems to me, might offer some solution to our problem. It will be a long time before we can be placed on any real legal footing requiring a definite standing, and if we cannot do that, we should do something else. This would have to be a voluntary movement in our ranks, and I believe it might be worked out to our advantage.

W. C. Fisher, New York City: Dr. Hoffman's paper could be discussed indefinitely; there are so many branches to it that the discussers have gone off at a tangent. I feel very much as I imagine a lawyer feels when taking a case. I could take any side of this question and argue for or against it. I have had some experience in orthodontic education and have been an earnest student of it, yet I do not believe, after nineteen years, that we have, or will achieve, any one ideal method of producing orthodontists. You will hear criticisms of short courses and a great deal in favor of the long course, and justly so. I believe that we are going to produce orthodontists tomorrow just as we produced them yesterday—through individual effort, purely and simply. It has produced the great specialists in medicine for the past fifty years and it will produce them in dentistry. One man can take a short course and get enough stimulus and sufficient knowledge therein to develop into a credit to his specialty. Others will fall by the wayside. Some of the best men that we have in our specialty today never even had a short course. Two of your speakers here today never have been allied with any of the so-called short course schools. The plan that is being tried in several universities, that is, the one and the two year plans, are still on trial. We do not know what they will produce; but we know this: they will not produce enough orthodontists; yet I do believe that they are going to produce a quality of man that is much to be desired. They should give us teachers of orthodontists and I hope some good research men, which a short course never could produce, but might stimulate. As far as Dr. Hoffman's remarks about having some standard or some periodical examination whereby we can see whether they are keeping up in the specialty of orthodontia, such as they are thinking of applying in Colorado to medicine and dentistry, that is possibly chimerical. It could not be done in a democratic form of government under the present day civilization. So let's forget that. We can only stimulate a man to advance. It is the individual effort of the leading men in the specialty, particularly in America and Canada (and a few abroad), that has placed the specialty on the high plane where it is today. It is no reflection on these men that nearly all of them are graduates of short course schools. It was merely the only method that was presented at that time. The short course has its evils and they are decided evils. It has its advantages. I will say that they are not so great as they looked at one time to be, but the people need orthodontists just as they need dentists. The public has been educated in the benefits of orthodontia and orthodontic treatment. They have seen a sufficient number of children greatly improved in every little community, and we know that when a man sees that his little girl is developing a severe deformity, he is going to seek service, too. If you are dissatisfied with present conditions, let us do as Dr. Waugh is trying to do, as they are doing in Illinois, in the University of Pennsylvania and other schools. Let us see if we cannot devise some way whereby we can supply a stimulus to these graduates to come out and take up the plan that Dr. Abell has spoken of, or any plan that will develop the orthodontist.

Frank M. Casto, Cleveland, Ohio: One of the speakers stated that the allurement of

specialization is still with us; one remarked that the delusions are also still with us, and there may be some truth in both. The discussion has resolved itself somewhat into the question of preliminary education or qualification for those who desire to enter a special field of practice. This subject has been discussed pro and con for, lo, these many years, and opinions are almost as varied as there are opinions. Some believe that substantially more instruction in orthodontia should be given to the undergraduate student in the dental schools. Others believe that only the fundamental principles can be taught. Most of the difficulty, I believe, lies in the fact that there never has been a real concerted effort on the part of the orthodontists to prescribe and establish a balanced, standardized course of study. Dental educators recognize the necessity for teaching orthodontics, but they are simply groping in the dark in regard to how it shall be taught and the content of the course. The orthodontists will have to assume these responsibilities, and until they make good on the proposition, nothing different can be expected. The problem is becoming more complex and more difficult of solution. The requirements in all departments have advanced so rapidly that the curriculum is already overloaded. At present, in all good schools, the four-year course of study comprehends from 4,800 to 5,000 hours, an average of approximately 1,250 hours per year, or about thirty-nine hours per week during the thirty-two weeks of instruction. About 100 hours are allotted to didactic and technic instruction in orthodontics. The number of hours in clinical instruction varies widely in different schools. It is quite obvious, under the present circumstances, that it is possible to teach only a limited amount of orthodontics. This is also true in other special branches. A dean of one of our best dental schools had a vision. He thought he had a method whereby the problem of rendering efficient instruction in special branches could be solved. He presented the proposition to his faculty, which briefly was as follows: There must be a minimum number of hours in each subject that would meet the requirements for general qualification, and which was less than the numbers of hours now in vogue, in which case a maximum number of hours would be available to those students who were particularly interested in some special subject, such as orthodontia, exodontia, prosthetics, and who developed some unusual ability or skill along certain lines, i. e., a student could, therefore, take the minimum number of hours on one subject and the maximum number of hours in another and still meet all of the requirements. He requested the members of the faculty to consider this matter carefully and report back to him. The result was that every man reported as a minimum requirement more hours than he previously had and a maximum requirement far in excess of any possible adjustment. The total number of minimum hours exceeded the present scheduled number by about 1,000, making a total of approximately 6,000, while the maximum was more than 8,000. The futility of such an arrangement is immediately evident. I simply call your attention to this incident to illustrate the utter hopelessness of attempting to give enough instruction to the undergraduate to qualify him for special practice. I should be derelict in my duty if I did not correct the statement made by one of the speakers in regard to the unlimited stress placed on mechanics in the dental schools today at the expense of the biologic sciences and didactic instruction. The curriculum in most schools presents a well-balanced course of study. With the induction of the preprofessional year, all of the courses in the fundamental sciences were advanced and enlarged, and the prerequisites were adhered to more conscientiously, and, as a result, the present-day dental student is receiving a fine education. The first two years is devoted mostly to the study of the basic sciences, in which extensive laboratory instruction is given. A considerable amount of time is given to didactic instruction throughout the four years. Certainly, the technic courses are as extensive as time will permit, and a large amount of time is allotted to practical clinical instruction. It could not be otherwise if a well balanced product is the goal.

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Editorial

CHRISTMAS AND THE SEALS

Around the sentiment of Christmas there clings the tenderest memories of our civilization. Once a year—at least once—we place a ban on selfishness, on sordidness, on meanness, on niggardliness; and we expand our hearts to take in the whole of humanity.

We have left the miser grip of gold, and beckoned in the dawning of a better day. We think more of others than of self—more of the home than of the mart. The hearthstone becomes the symbol of our purest faith, and we worship at the feet of family and of friends. And this is real religion—the religion to regenerate the world.

The fireside is the most sacred shrine of our existence—the altar on which we place the benison of our best offerings. It is here we sink the sin and shame of selfish greed, and touch the tender chord of love's sublimest lay.

We open wide the arms of charity and hope and draw into our embrace the needy and forlorn. We worship to the hymn

of childhood's happy laugh, and bow our heads in reverent awe for the wavering voice of faltering age.

All men are brave, all women are beautiful at this blessed season of cheer and heartiness. The good is so easy to do, and the bad is banished from the hearts and thoughts of all.

Happiness reigns supreme and no soul is so sordid that it can keep out all of the sublime radiance.

Hope springs eternal in the human heart, and all that was or is of hate and grief and woe is buried in the purling stream of heartiness and cheer.

It is the realm of childhood's happy reign, where babes are kings and wield with dimpled hands their loving scepters over the willing hearts of men.

The Yuletide is the season of the hearthstone and the holly, and within the hallowed portals of the home there dwell the purest thoughts, the purest joys, that come to mortal man.

Christmas makes the whole world kin, and every vagrant thought or ill design is winnowed from the minds of men.

At mother's knee we learned to lisp the legends of the past—the chimney tale; the sleighride troop in moonlit air, where reindeer leap from roof to roof in bounding glee; the tinkling of the bells and the creaking of the runners over frozen snow; the tiny stockings hung with childish faith near the open grate; the stillness of the winter night with blinking stars high up in heaven's dome—it all comes back—and care is gone, and hope is high, and smiles are bright, and life ascends the heights of purest joy.

Christmas is the herald of charity and cheer, the beckoning in of peace on earth, good will to men; when the miser scatters his gold and the sluggard forgets his sloth; when hearts beat high and the souls of men are tuned to the rhythm of eternal hope.

We know not till now the real sublimity of our better nature, when out on the wings of impulse we soar among the lofty peaks of high resolve and wave a benison to all the world.

Pity the time could not all be Christmas, and pity our hearts

could not all beat true. Earth's fairest flowers would be pale and odorless beside the radiance and perfume of human acts and human aid. Mankind in its better moods is Nature's greatest glory—the one supreme and thrilling feat of earth's sublimest art.

And to the members of our own craft there comes the opportunity at each Christmas tide to expand their sympathetic hearts and think for a moment of those of their fellows who are not so well favored as they. The Christmas Seals form a handclasp between the fortunate and the unfortunate among the members of the American Dental Association. Each year they go out as a pleasant reminder that a relief fund is to be augmented for the benefit of those whose advancing years or other disability is rendering them incapable of self maintenance, and whose sole support must come from outside aid. What more appropriate than that the members of their own calling should come to their succor.

The burden of the seals is so light on each member that it is wholly negligible—in fact, it should not be considered a burden at all, but a delightful privilege. Every man who remits for the seals will feel his heart expand as he writes the small check, and he will go about his daily task with a brighter smile, and a cheerier song.

Let us unite this year and reach out with hand to heart, from one end of the land to the other, and make the response one hundred per cent of charity and cheer.

(We are just in receipt of a very urgent appeal to our members by that veteran of the Relief Fund, Dr. L. G. Noel, which lack of space compels us to limit to the brief but eloquent statement that every member of the Association is in duty bound to contribute his mite to the fund by remitting at once for the seals.)

THE TEACHERS IN OUR DENTAL SCHOOLS

The season is now upon us when one of the most important of our professional activities relates to the kind of work that is being done in our dental schools in the way of instructing young men and women in the fundamentals and technical details of a

college education. When we stop to consider that the future of the profession depends on the training given the students of today, the significance of this training must be apparent to everyone. And yet we fear that many of our teachers approach their task in too much of a routine and matter-of-fact manner. The full force of their obligation never seems to be borne in on them, and they appear oblivious to the sacred obligation which they assume when they elect to become instructors to those who, in the future, are to be entrusted with the welfare of the public and with maintaining the good name of the profession.

The function of a teacher in a dental school is not confined to the mere problem of imparting technical or scientific instruction. It does not begin and end in the preparation of students for college or state board examinations. This should be considered simply an incident—an important incident, it is true—in the program of a teacher in a professional school. He should look beyond this in an adequate conception of his whole duty in the matter, and should try to visualize the results of his work in a better service to the public on the part of those who are placed under his care in college.

And by a better service we do not mean merely the ability properly to perform technical operations on the teeth—to make fillings, to insert artficial dentures, to construct crowns and bridges, or to do any of the other practical work demanded of the dentist. All of this must be taken for granted; all of this is a patent necessity in the training of a student, and without it the training is faulty. But above and beyond this there is a fundamental requirement for a professional man, to which the attention of teachers seems seldom directed.

It is well, and altogether praiseworthy, that a teacher makes the student an acceptable operator; but in the sum total of what constitutes a true professional man, it is of infinitely greater importance that he makes of him a clean-cut, cultured and honorable gentleman. No man may be considered of real professional caliber without those fundamental virtues of basic morality and

correct living which hark back to the best traditions and most lofty conceptions of a well-grounded professional life.

And if these ideals are to become part and parcel of a student's after life, they must be instilled in him during his college days. Habits formed at this impressionable period of life are very tenacious, and it is to the credit of our young men that so many of them prove true to the trust that is reposed in them, and live up to the professional heritage that has been handed down to them by their predecessors.

It has been the glory and grandeur of the professions that they have achieved a status in the eyes of the world which has raised them in respect and esteem above even the most honorable of the commercial pursuits; and if this status is to be maintained, it will be only by virtue of the most rigid adherence to the tenets of professional ethics as represented by the sacred obligations of unselfish devotion to duty.

This then should be the major theme in the minds of the teachers in our schools, and they should watch with zealous care the tendencies among the student body, with the thought always in mind of checking everything evil and encouraging everything good. But let it be said that the lessons taught should not be in the nature of continual preaching or pedantic moralizing.

Nothing is so likely to pall on a student as perpetual harping on morals or indulging in cant of any kind. To be prosaic or to assume a holier-than-thou attitude is fatal to a teacher's influence with a class. A little straightforward man-to-man advice at opportune moments; a frank and unobtrusive interest in the physical and moral welfare of the boys at all times—entering into their problems and aiding them in their dilemmas; encouraging them in all legitimate recreations and fun; establishing a real comradeship with them which is hearty, and yet not too familiar—in short, exhibiting a genuine concern that their connection with the school may develop them along constructive lines and round them out into the type of professional men who shall in the future add luster to dentistry and assure their

own success in life—this is the kind of influence which will most surely count with a class of students.

And more effective even than all of this is the daily example set by the teacher himself. To live a good, clean upright life, "four square to the world" and beyond reproach, is to produce a greater effect for good on a body of young men than any amount of lecturing or admonition. Let the teacher never imagine that he can live an unworthy life, and the students not know it. There is about every class a vast factor of psychologic intuition which is unerring in its judgments, and no teacher can ever hope to obscure his daily life from a student's keen observation.

If a man elects to play fast and loose with his morals, he would better abstain from teaching in college. He may be sure of one thing, that his sins will find him out; and it is unfair to students and derogatory to the best interests of the profession to have any ulterior or bad influence associated with our educational institutions.

The function of an instructor in a professional school is a very important one, and the obligation becomes so sacred that no man should permit himself to accept such a position without first studying its exactions in the most intimate way, and then pledging himself to a life of sacrifice and the most sublime self-abnegation. Armed in this way, he may enjoy the inspiring prospect of doing great good, but lacking this, he will be faced with the depressing thought that he is likely to work more harm than benefit among those who are soon to direct the destinies of our profession.

DEPARTMENT OF DENTAL HEALTH EDUCATION

THE ORIGIN AND HISTORY OF THE DENTAL HYGIENIST MOVEMENT*

By ALFRED C. FONES, D.D.S., Bridgeport, Connecticut

A SEARCH has been made in the American dental periodical literature to trace (1) the development of dental prophylaxis as a part of the practice of dentistry, and carried out by the dentist, and (2) the development of dental prophylaxis as an auxiliary branch of dentistry, practiced by lay women, trained for this purpose and limited to this specialty.

The first dental periodical in this country, the *American Journal of Dental Science*, was published in 1839, and as early as 1844 it carried an editorial under the caption "Dental Hygiene."[1] The author, who was undoubtedly one of the three editors, Chapin Harris, Edward Maynard or Amos Wescott, deplores that so much attention is given to therapeutics, mechanical dentistry and surgery, and "the hygiene of the teeth almost wholly neglected." The editorial says in part, "Certainly there is no part of the physical organism to which prevention of disease can be more successfully or effectually applied than to those organs (the teeth). The hygienic treatment recommended by L. S. Parmly for the teeth is the most successful that has ever been instituted. It consists in cleaning the teeth regularly four or five times a day with waxed floss silk. Every dentist should be provided with an abundant supply and should furnish every one of his patients with it, and such other material as may be necessary to enable him to keep his teeth thoroughly clean." Mention was made that the American Society of Dental Surgeons was to issue correct information through tracts or pamphlets "to promote dental hygiene." Thus, in the first stages of the dental hygiene movement, the responsibility for maintaining a clean mouth was put entirely on the patient.

In 1865, under the same title, "Dental Hygiene," Henry S. Chase[2] advanced the idea that the diet, especially during the prenatal period, was the most important factor in dental hygiene. He made no mention of cleanliness in relation to the teeth.

The first paper to be entitled "Prophylaxis or Prevention of Dental

*Read before the Section on Mouth Hygiene, Preventive Dentistry and Public Health at the 7th International Dental Congress, Philadelphia, Pa., Aug. 24, 1926.

1. Dental Hygiene, editorial, Am. J. Dent. Sc., 5:244, 1844.

2. Chase, H. S.: Dental Hygiene, Tr. A. D. A., 1865, p. 51.

Decay" was written by Prof. Andrew McLain[3] of New Orleans Dental College, and published in 1870. This author had an appreciation of diet, especially prenatal, and of mouth sanitation as carried out by the patient. In the literature of this period, quite frequent references were found to the dietary as an important factor in relation to diseases of the teeth and gums, but it was not until 1879 that any stress was laid on the cleaning of the teeth as carried out by the dentist. In an able article by G. A. Mills of Brooklyn[4] on "How to Keep the Teeth Clean and Healthful," the cleaning and polishing of the teeth is strongly urged, and this was practiced by the author, although he did not offer any special system for accomplishing his results. The first reference made to that now indispensable instrument, the explorer, was found in Dr. Mills' paper.

M. L. Rhein of New York City,[5] in an article entitled "Oral Hygiene," brought his prophylactic toothbrush to the attention of the profession in May, 1884, and advocated that the dentist should make a pupil of his patient and teach him how to brush his teeth effectively.

In later years, when the terms prophylactic and prophylaxis appeared frequently in our literature, discussions arose and claims were made to originality in the use of these words. Dr. Rhein claims to have been the first to have used the adjective, prophylactic, but reference was found to a work by Arthur of Baltimore in 1871[6] advocating "prophylactic measures as preventive of decay." Likewise, D. D. Smith of Philadelphia claimed to have first applied the term prophylaxis in dentistry, but reference has already been cited to the use of this word in McLain's paper of 1870.

It is not my intent to trace the earliest use of these terms in dentistry, but I deemed it interesting to report their first appearance in the literature reviewed.

During the late eighties, considerable interest was developing in dental hygiene, the term being then applied mostly to the necessity for effort on the part of the public to maintain clean mouths. The South was especially active in this matter of public education, and, in 1887, the Alabama Dental Association advocated "a public lecturer on Dental Hygiene," and adopted the following resolution:

> WHEREAS, the rapid strides that are being made by our profession in all its branches impose on us the additional duties of making known to the people in some practical way the advantage to be derived from instruction in Dental Hygiene;
>
> *Resolved*, That the time is now at hand when a practical lecturer should be employed, and instructed to visit our schools, both public and private, and deliver lectures of a plain and simple character to the pupils, instructing them in the proper care for the teeth.

The resolution was referred to the Southern Dental Association in 1888, and a committee was appointed to look into the matter.[7]

3. McLain, A. F.: Prophylaxis or Prevention of Dental Decay, Dent. Reg., 24:158, 1870.

4. Mills, G. A.: How to Keep the Teeth Clean and Healthful, Dent. Cosmos, 22:21 (Jan.) 1880.

5. Rhein, M. L.: Oral Hygiene, New England J. Dent., 3:315 (Oct.) 1884.

6. Report of Ohio Dental Society, December, 1871, wherein Dr. J. Taft reports Dr. Arthur's work, Dent. Office & Lab., May, 1872.

7. Tr. Southern Dental Association, Southern Dent. J., 1888.

One of the most comprehensive outlines of prophylaxis, and one that conforms almost identically with our views today, was advanced in 1890 by Charles B. Atkinson[8] of New York City. The introduction to this paper, "Prophylaxis in the Field of the Dental Surgeon," is quoted as follows:

> Prophylaxis presents four closely related and two attendant aspects for consideration.
>
> 1. Prevention, properly a broad effort of education to teach to avoid.
> 2. Diet, a means of preparation of the system to assist prevention.
> 3. Hygiene, a regulation of circumstances closely governing (prevention).
> 4. Regimen, ruling of use of system, food, article and circumstance under the instruction of the preceding aspects; add to these, operative and medicinal interference in the progress of disordered and diseased conditions, and the breadth of prophylaxis is before us.

Dr. Atkinson undoubtedly *had* visualized the scope of prophylaxis and ably outlined it, although a perusal of his paper did not disclose an appreciation of the necessity for the treatment of prophylaxis, as we apply this phrase today.

In the early nineties, much was written on various phases of this subject, but it remained for D. D. Smith of Philadelphia, with his forceful and convincing arguments and demonstrations, to impress the dental profession thoroughly with the importance of the dental prophylactic treatment. Dr. Smith states in one of his papers that, in 1894, he started the surface treatments for the prevention of decay and the general betterment of mouth health for the members of his family and a few selected patients. After four years of this service, he was so impressed with the results that he gave a talk entitled "Prophylaxis in Dentistry," Feb. 15, 1898, before the Washington City Dental Society, and, in October of the same year, elaborated the talk into a paper of the same title read before the Northeastern Dental Society at Hartford, Conn.[9]

His paper was so well received that he was invited to appear again before that society at Holyoke, Mass., in 1899. At this time, he had been increasing the number of patients under this form of treatment and, in the year 1900, gave two exhibits of his patients. From this time on, he presented this subject before numerous societies, and held ten or twelve exhibits in his office for the benefit of large groups of dentists.

In the extensive material reviewed on the subject of dental prophylaxis, it was the consensus of opinion that D. D. Smith was truly the father of dental prophylaxis. Although other men had made the effort to impress the dental profession with the importance of mouth cleanliness, he was the first to evolve a definite system of dental prophylaxis and offer his technic to the profession, and to show clinical evidence through his exhibits of patients, of the beneficial results of his system. To quote Dr. Smith in this regard, "The discovery and enunciation of the important fact that enforced and systematic change in the environment of the teeth will prevent decay, and carry with it many other beneficial results, is new, new in essence, new in conception, and new in its elaboration; and results wholly from clinical investigation, and experimentation." It will be noted that, for the prevention of dental caries,

8. Atkinson, C. B.: Prophylaxis in the Field of the Dental Surgeon, Internat. Dent. J., 1891, p. 371.

9. Smith, D. D.: Prophylaxis in Dentistry, Internat. Dent. J., 1899.

Dr. Smith stressed only the environment of the teeth. He did not concede that nutrition or other hygienic factors that govern the health of the body as a whole were influential in the susceptibility or immunity to dental caries. His teachings still form the basis of our knowledge regarding the operative technic of dental prophylaxis, and he justly deserves great credit for this. In the light of our present-day knowledge, the true prevention of dental disease covers a wider field than operative procedures for extreme cleanliness, although these measures must play an important rôle.

In tracing the history of dental prophylaxis as an auxiliary branch of dentistry, practiced by lay women trained for this purpose and limited to this specialty, it was thought apropos to mention briefly the development of the idea of utilizing women in dentistry.

In 1866, James Truman of Philadelphia, in an address before a dental graduating class, took for part of his theme the admission of women into dentistry through the then closed doors of dental colleges. The suggestion was so at variance with the accepted thought and practice of this period that the idea aroused amusement, and even indignation. By 1869, however, two women had been admitted and graduated from two separate dental colleges, and Dr. Truman made bold to offer a resolution before the American Dental Association that women should be admitted to full membership in subordinate associations, but the resolution was unanimously tabled at once.[10]

N. W. Kingsley, in 1884, wrote a very complimentary paper called "Woman—Her Position in Dentistry."[11] He advocated the acceptance of women as assistants to dentists, to help at the chair; and he said, "When she becomes familiar with the details of practice, she will perform all operations required upon deciduous teeth, including fillings with any of the plastics, she will take entire charge of the regulating cases, and that branch of practice, so dreaded by all because of the apparent waste of time, in the rearrangement of splints, becomes in her hands a valuable source of income. In short, it is impossible to enumerate in detail the acquirements she will come to possess." He did not mention cleaning especially. Probably this was considered too unimportant. He did not believe women were suited to become graduate dentists because "They are inexact and not inventive."

Only very meager references could be found to women in dentistry previous to 1900, and not many printed records were located to show that women were generally employed in dental offices to any great extent.

The search for the first suggestion of training lay women to aid the dentist in the cleaning and polishing of the teeth as a separate specialty in a dental office has brought to light the work of C. M. Wright of Cincinnati, Ohio, a man of high standing and long experience in our profession. In January, 1902, Dr. Wright presented a paper before the Odontological Society in Cincinnati entitled "A Plea for a Sub-Specialty in Dentistry," and it is to be regretted that his paper cannot be given

10. Internat. Dent. J., April, 1902.

11. Kingsley, N. W.: Woman—Her Position in Dentistry, Herald of Dentistry, 3:1 (Jan.) 1884.

in full.[12] A considerable part is quoted as follows:

1. The practitioners of this separate and yet most important part of dentistry are to be women,—women of education and refinement,—who are seeking a field for work of an honorable and useful kind and among people of culture.

2. The dental colleges are to offer opportunities for this partial and separate training. The course to consist of lectures on the Anatomy of the Teeth and Gums, Special Pathology, and Physiology, and a special clinical training in prophylactic therapeutics.

3. Upon the completion of this special course, which shall require one session, or one year of study, and practice under instruction in the college infirmary, and after presenting satisfactory evidence of proficiency in the polishing of teeth and caring for the mouth, the college shall grant a certificate of competence to the graduate of this course.

4. With this training and the dental college certificate, these ladies may be employed by dentists for this special work, or may practice at parlors of their own, or at the homes of patients, the dentists using their influence and recommending the new specialists, just as physicians and surgeons recommend and insist upon the services of the trained nurse or the masseuse.

This is but an outline of a scheme, the details of which seem easy of arrangement.

Dr. Wright says, further:

I think every one of you will agree with me that there could be no more valuable service in oral hygiene than just such a class of specialists would afford.

About twenty-five years ago, in Basel, Switzerland, I mapped out a scheme for a new specialty in dentistry for a woman of education who applied to me for advice. She wished to earn a living, yet did not desire, or feel able, to enter into the full work of an accomplished Doctor of Dental Surgery. I then planned for her the kind of work which shall form the subject of my talk this evening. She did not follow my suggestions and fit herself for this specialty, because it was not feasible at that time and place, but this circumstance did not affect my opinion of the excellence of the idea.[13]

The time has arrived when I believe we should make it possible for and encourage just such applicants to enlist in this field of useful service.

Ten years ago I explained the same scheme to another lady who sought advice about entering the profession of dentistry. This lady was convinced by my picturesque and enthusiastic advocacy of the "Specialty within a specialty," but as there appeared no opportunity for acquiring the education necessary for the practice of the vocation, she was compelled to abandon the plan.

The recent papers by Dr. D. D. Smith of Philadelphia, on the prophylactic value of a certain dental operation,—namely, the expert polishing of the human teeth, beginning with the children and having regular and frequent appointments and systematic attention in this one direction, and continuing it possibly throughout life,—has appealed to me so forcibly that I have felt that suggestions on "A Sub-Specialty in Dentistry," devoted to the polishing of the teeth and the massage of the gums, might be apropos.

We have given ourselves over to restoration and been content to advise tooth brushes, sanatol, or vegetol to our patients, leaving the responsibility of real prophylaxis with them. We may not be able to change our modes and habits of practice, but we can, by this method and with the hearty cooperation of the dental colleges in affording the educational equipment necessary for the cultivation of this field of special practice, revolutionize dentistry—place it upon a still higher plane. The operation suggested is more directly in the line of preventive medicine, with all that this implies, than any other in the scope of prophylaxis that I can think of, such as boiled drinking-water, ventilation, sanitary plumbing, physical exercise, diet and bathing. Imagine a room full of children, as they are now in any school, public or private, in regard to surgically clean mouths, and the same children after a thorough polishing of all their teeth. Here is an opportunity for missionary work. Enthusiasm on the part of the operator and patient could easily be stimulated, and health and morals be vastly improved. Ten years

12. Wright, C. M.: Plea for a Sub-Specialty in Dentistry, Internat. Dent. J., 23:235 (April) 1902.

13. Thus Dr. Wright conceived this plan about 1877.

of such effort on the part of our profession would do more for the human family than all the tooth-pastes and powders ever invented, or all the tracts for the people ever published, for the responsibility would be removed from the patient and placed where it belongs—on the practitioner of this art of oral hygiene, these sub-specialists.

We have set the men on pedestals who have been able to cut out a carious spot on a tooth, extend and form a cavity so that a clean surface of gold may take the place of enamel and protect one part of a single tooth from a single disease; shall we not commend and honor the specialist who patiently and regularly operates for the prevention of this and other diseases by intelligent and systematic care of the entire mouth? This is a fundamental idea of dentistry, agreed by all and yet neglected.

With our present exact knowledge of etiology and our increasing familiarity with the wide-reaching effects of oral sepsis, are we not ready for the establishment and hearty endorsement of trained specialists who will devote their entire time to this one branch of prevention? From personal observation among refined people in America and Europe, I believe success will follow the efforts of the colleges and the profession in this direction, for we shall be supplying an awakening demand for just such service.

Later, in 1902, when some fears had been expressed that a partially educated sub-specialist would drift into illegal practice of dentistry, Dr. Wright, in a paper entitled "Preventive Dentistry," answered these objections:

> The fact that the partially educated dental profession does not trespass on the private domain of the physician and also that these women must be largely dependent upon the recognition and recommendation of the dentist for their employment, seems to me a barrier against invasion, and a protection against infringement. Then *we* are supposed to be controlled by state laws regulating practice and a modification of these laws might be adopted that, while permitting these specialists to practice would also control and limit them as *we* are controlled and limited. It seems to me the women practitioners of this well defined sub-specialty would gladly remain within the scope of their privileges.[14]

Dr. Wright repeatedly presented his plan at various gatherings of dentists. It seems remarkable that a man should have had, in this early period, such a comprehensive view of this field of service for women and its value to dentistry and the public. It shows that Dr. Wright had given previously years of careful thought to this subject and had even visualized its possibilities for good among the children in our public schools. He also had an appreciation of the necessity for intelligent legislation for the regulation of her practice. Unquestionably, Dr. Wright must be given credit as the first one to have visualized properly the dental hygienist as we know her today.

In August of the same year (1902), F. W. Low of Buffalo, N. Y., inspired by D. D. Smith with the thought of systematic polishing of the teeth, brought forth his suggestion of the "Odontocure." Dr. Low said: "I read a little paper before the City Dental Society in Buffalo in which I advocated a new profession—that of odontocure—a girl with an orange wood stick, some pumice, and possibly a flannel rag, who shall go from house to house."[15] He advocated polishing the teeth in this way every two weeks, and suggested that possibly 50 cents would be the charge.

It is apparent that he was so impressed with the universal need for clean and polished teeth that he desired the service to be available to everyone in a convenient and inexpensive way.

The next record in dental literature

14. Preventive Dentistry, Proc. Southern Dental Association, 1902.

15. Disc., Items Int., 1902.

is a paper by M. L. Rhein of New York City, entitled "The Dental Nurse." This was presented to the Section on Stomatology of the American Medical Association, May 5, 1903, and practically the same paper was read again before the New York State Dental Society, May 13, 1903.[16]

Dr. Rhein had, for many years previous to his presentation of these papers, an appreciation of the great value of mouth hygiene, and the suggestion of the name "dental nurse" coming from one so prominent in the profession, and experienced in dental prophylaxis, gave the cause the impetus it so much needed.

The following extract from Dr. Rhein's paper will show clearly his great interest in this matter. In discussing the reasons why prophylaxis was neglected, he pointed out that the repair of existing lesions in tooth structure and the adjacent tissue takes up all the time of the man with the average practice, and says further:

> The difficulty of receiving commensurate pay for the hours of time required in faithfully carrying out the treatment by prophylaxis brings up the question of expediency. It is true that Dr. Smith of Philadelphia claims to personally give his patients this treatment at regular intervals. If an effort were made to follow out this method in an average practice there would be time left for nothing else. It certainly is the consensus of professional opinion that the busy practitioner cannot give up his valuable time for this tedious, monotonous and irksome labor, however important it may be for the salvation of the human teeth. A small number of us have tried to solve this important problem by employing an assistant practitioner to attend to this department. In the judgment of your essayist, who has tried this method for twelve years, it has failed to satisfactorily solve the problem.
>
> The employment, in a private office, of a graduate to make a specialty of this work is very likely the best remedy we have had at our disposal up to the present time. The greatest objection to this plan is the inability to retain a graduate possessing ordinary ambition and talent a very great length of time in this position. In discussing this subject with prominent men it has been generally conceded that far better results could be obtained if suitable female assistants, not graduates, were especially trained and employed for this work.
>
> In view of the high esteem held for the work of the trained nurse, it appears remarkable that the sphere of her usefulness has not long since been extended to our own specialty. It would be an easy matter to add to the training schools for nurses a department for dental nurses. Applicants for admission to such a course would be required to pass a satisfactory preliminary examination. Outside of the general didactic instruction which they would receive, they would obtain additional instruction in regard to the oral cavity, etc., from a dental member of the school's faculty. They would also receive their manual training under the same supervision, and in the hospital material they would find ample opportunity for perfecting their working technique.
>
> Having graduated from the training school, it would be in keeping with our other laws to compel the nurses to pass a state board examination. The passing successfully of such an examination would then entitle them to be registered as trained dental nurses. Being so registered, they would be able to practice their profession in private life. By that is not meant the fact that they would be licensed to go around indiscriminately, cleansing the mouths of the people. Their license to practice dental nursing should mean that they are permitted to cleanse, polish and medicate the dental territory only under the prescription of the patient's attending dentist.
>
> In conclusion I might say that there are three important reasons why the plan above outlined for the introduction of dental nurses should meet with your approval:
>
> First. It will tend materially toward the public good.
>
> Second. It will open to womankind a new vocation second to none in desirability.
>
> Third. It will materially aid the stomatologist in the quality of his results.

16. Rhein, M. L.: Dent. Cosmos, 45:628 (Aug.) 1903.

This plan of Dr. Rhein's was so well received that the Section on Stomatology of the American Medical Association unanimously adopted a resolution commending it, with the hope that it would lead to action being taken by the proper agencies to amend the dental laws to legalize the employment of dental nurses. In the New York State Dental Society, after much favorable discussion, and little unfavorable comment, F. T. Van Woert of Brooklyn offered the following resolution: "Resolved, that the New York State Dental Society do hereby recommend the Legislative Committee to use their best endeavors to have the dental law amended in conformity with the views expressed in the paper on 'Trained Dental Nurses.'" The motion to adopt this resolution was put and unaimously carried. Thus, it is that through Dr. Rhein's efforts, and with the support of many prominent dentists, notably Thaddeus P. Hyatt, R. Ottolengui, F. T. Van Woert, William Jarvie, John J. Hart and others, the New York State Society was the first to attempt to legalize the dental nurse. Although the movement had the backing of many of the foremost dentists in the state, the dental law was not thus amended until 1916.

The record of my activities is next in order. My thoughts were directed to prophylaxis by D. D. Smith in a paper and clinic on this subject before the Northeastern Dental Association in the fall of 1899, and through Levi Taylor of Hartford, one of Smith's first converts and most enthusiastic followers, I was thrice invited to Dr. Smith's office to attend his exhibits of patients. Returning from my first visit to these exhibits with Dr. William Jarvie of Brooklyn, I commented on the inordinate amount of time that such a system as Dr. Smith's would require in dental practice, and suggested that it might be possible to train a woman specially to perform this operation. Dr. Jarvie agreed with the idea, and he lived to see the dental hygienist movement well under way. Before his death, he confirmed by letter his recollection of our conversation in 1900.[17]

It is interesting to note the similarity of thought of so many dentists who were inspired by D. D. Smith to a realization of their responsibility to practice dental prophylaxis, but recognized at once their ultimate inability to devote a sufficient amount of their time to this branch of preventive dentistry. The suggestion as to training women to perform prophylactic treatments seems to have been advanced by Drs. Wright, Low, Rhein and me, and possibly others, independently, and no one seems to have received the inspiration for his idea from the others. It was, no doubt, a strong argument for the great practicability of the thought, that it should occur almost simultaneously to several different individuals, who were alike inspired with a deep desire to see dental prophylaxis made a feasible part of the office routine.

It was not until 1905 that, having evolved in 1901 a system of prophylactic treatments for use in my own office, I found it no longer feasible to carry on these treatments without aid, and I undertook the instruction of my office assistant, Mrs. Irene Newman. She began prophylactic work for the patients in February, 1906, and has been in continuous practice in the same office for twenty years.[17] As far as we know, Mrs.

17. Fones, A. C.: Office records.

Newman was the first lay woman to practice dental prophylaxis.

In 1907, the Connecticut dental law was amended to make it unlawful for dentists to employ unlicensed assistants for operative work in their offices. As chairman of the Legislative Committee of the Connecticut Dental Association, I advocated a clause to the effect that this amendment should not prevent dentists from employing assistants for the "so-called operation of cleaning teeth." This clause, being then adopted, was the first provision ever made in a dental law to legalize the prophylactic treatment when performed by an operator who was not a graduate dentist, but specially trained for and limited to such work.

My interest in this subject led me to accept the appointment of lecturer on dental prophylaxis at the New York College of Dental and Oral Surgery, in 1907, and to appear before many society meetings with papers and clinics on my technic. I was so enthused by the beneficient results secured through dental hygiene in my own practice that, beginning in 1909, I inaugurated a campaign to secure similar prophylactic service for Bridgeport, Conn., school children, in contradistinction to relief and repair dental clinics.[17]

It took four years of strenuous effort to convince the city officials, but finally, in 1913, $5,000 was appropriated to the board of education to conduct the first demonstration of the value of an educational and preventive dental clinic. It at once became necessary to train a number of women to carry on the demonstration. I determined to enlist the aid of professional men and to train a number of women in my office building, where there were excellent facilities for such a course. As early as 1911, in analyzing the special type of service that these women were to perform, I felt that the name "dental nurse" was a misnomer, and I tried to think of a name to designate these health workers that would not create an association in the mind with the treatment of diseases. The name "dental hygienist" was finally evolved, and has been generally accepted.

Thus it was that, in September, 1913, an announcement was issued of the first course for dental hygienists at Bridgeport, Conn., reading, in part:

> In the last few years, there has been a great demand for women as hygienists and prophylactic operators in dental offices, for it is a well known fact that at least 80 per cent of dental diseases can be prevented by following a system of treatment and cleanliness. There is also now developing a demand for these women in public institutions, such as schools, hospitals and sanitoriums. At the present time, there is no standard educational courses for dental hygienists. The demand for these women throughout the country is sufficiently large to warrant a course of lectures to be given by men who are authorities in their various specialties, these lectures to be printed in book form. With the possibility that this movement will be a powerful aid in the prevention of disease, these educators have agreed to give their services gratis. After the lecture course, there will be six weeks of practical training in dental prophylaxis. A nominal fee of twenty dollars will be charged to partly cover this expense.

The men who so generously agreed to aid this cause were: Raymond C. Osburn, Ph.D., professor in Barnard College, Columbia University, New York City; Alexander M. Prince, M.D., instructor in medicine and physiology, Medical Department, Yale University; L. F. Rettger, Ph.D., assistant professor of bacteriology, Sheffield Scientific School, Yale University; R. H. W. Strang, M.D., D.D.S., Bridgeport,

Conn.; George M. Mackee, M.D., instructor in dermatology, College of Physicians and Surgeons, New York City; Edward C. Kirk, Sc.D., D.D.S., dean of Dental Department, University of Pennsylvania, Philadelphia, Pa.; Eugene H. Smith, D.M.D., dean of Dental Department, Harvard University; M. L. Rhein, M.D., D.D.S., New York City; R. G. Hutchinson, Jr., D.D.S., New York City; R. Ottolengui, M.D.S., New York City, editor, *Items of Interest;* Charles M. Turner, M.D., D.D.S., professor of mechanical dentistry and metallurgy, School of Dentistry, University of Pennsylvania; Russell H. Chittenden, Ph.D., L.L.D., Sc.D., director of Sheffield Scientific School of Yale University; M. I. Schamberg, M.D., D.D.S., New York City; Herman E. S. Chayes, D.D.S., New York City; C. Ward Crampton, M.D., hygienist and director of physical training, Public School System, New York City; Prof. Irving Fisher of Yale University, chairman of Committee of One Hundred on National Hygiene; William G. Anderson, professor and director of Yale University gymnasium; Thaddeus P. Hyatt, D.D.S., New York City.

Their lectures were later compiled into the book, "Mouth Hygiene, the First Text Book for Dental Hygienists," compiled and edited by me, with R. H. W. Strang of Bridgeport, Conn., and E. C. Kirk of Philadelphia, Pa., associate editors.

Nov. 17, 1913, thirty-three women, including school teachers, trained nurses, experienced dental assistants and the wives of three practicing dentists, began the course, and, June 5, 1914, twenty-seven were graduated as dental hygienists. This group of women, coming as they did from various parts of Connecticut, organized on their graduation, June, 1914, the Connecticut Dental Hygienists' Association. This, the first state association of dental hygienists, has held an annual convention since 1915, and had grown to 135 members in 1926.

In the fall of 1914, ten enthusiastic hygienists began their pioneer work in the Bridgeport, Conn., public schools. This demonstration directed by me, with the help and advice of a local committee of most cooperative dentists, was planned on a five-year basis, so that the large group of the same children progressing from the first to the fifth grade could follow the dental hygiene program over that period, and could be used for statistical purposes and be compared with the fifth grade control class, which had no mouth hygiene program. The gratifying results of this demonstration have frequently been published in detail, and the success of the dental hygienist in the first educational and preventive dental service for school children is now a matter of record.

In 1915, an appropriation for additional dental hygienists for the Bridgeport public schools, and a persistent demand from other sources for these trained women, necessitated the second dental hygiene course, and a third and last course was held in 1916, at which time organized institutions took up the training of dental hygienists. A total of ninety-seven hygienists were trained in the three Fones courses. The field of service of hygienists was extended beyond private dental offices and the public schools, when, in 1915, a graduate of the Fones course was installed as a resident hygienist in the New Haven Hospital, and again, in 1917, when a

hygienist was employed to provide prophylactic treatments in the industrial dental clinic for the employes of the Yale & Towne Lock Company of Stamford.

The Fones hygienists who were completing their course in 1917, when war was declared, had the unique experience of working in May of that year for the national guardsmen who were mobilized in Bridgeport, and graduate hygienists in this vicinity continued to carry out the same program for the drafted men, utilizing the equipment of the training school. After the cleaning and examination of the teeth, each soldier was supplied with a toothbrush and given individual instruction in the care of the mouth. They were then referred to the local dentists who had responded to our appeal for operative work for these men. This was several weeks previous to the organization of the Preparedness League of American Dentists, and, as far as we know, was the first organized effort to provide dental service for our soldiers. The hygienists cleaned the teeth of 600 soldiers.

In 1915, the increasing number of hygienists in Connecticut, and the possibilities of the future growth of this profession, prompted me to draw up and urge the adoption of an amendment to the Connecticut dental law to regulate the practice of these auxiliary workers. This, having been adopted, legally prescribed for the first time the field of operation of the dental hygienist, and served as a precedent to the majority of the states that subsequently adopted similar clauses. The original dental hygienist practice act is quoted as follows:

> Any registered or licensed dentist may employ women assistants, who shall be known as dental hygienists. Such dental hygienists may remove lime deposits, accretions, and stains from the exposed surfaces of the teeth and directly beneath the free margins of the gums, but shall not perform any other operation on the teeth or mouth, or on any diseased tissues of the mouth. They may operate in the office of any registered or licensed dentist, or in any public or private institution under the general supervision of a registered or licensed dentist. The dental commission (state board of dental examiners) may revoke the license of any registered or licensed dentist who shall permit any dental hygienist, operating under his supervision, to perform any operation other than that permitted under the provisions of this section.

It is worthy of note that, during these early events, there was never at any time any organized opposition to the dental hygienists from the dentists of Connecticut. The spirit of cooperation was everywhere felt, which accounts in a great measure for the fact that Connecticut was the first state in the country to make a rapid advancement in this movement.

In Massachusetts, as early as 1910, an amendment to the dental law permitting the practice of the dental nurse, was introduced into the legislature, but it was defeated. There were dentists in Massachusetts who desired to utilize the services of a woman in their private offices as early as 1902. Dr. Wright, in one of his papers, spoke especially of S. A. Hopkins of Boston, but the threats of the dental commissioners to prosecute whoever attempted to use a prophylactic operator, other than a dentist, were so effectual as to prevent it. There were many strong advocates for the dental hygienist, notably W. P. Cooke, Carl R. Lindstrom, George H. Payne, Charles M. Proctor, Eugene H. Smith, LeRoy M. S. Miner and others, who kept this matter before the profession until, in 1915, the dental law was

amended to permit the use of these auxiliary workers.

In New York, this matter was agitated, as stated previously, from 1903 until the passage of the dental hygienist amendment in 1916.

Shortly after the legalizing of the dental hygienist in Massachusetts and New York, three training schools were organized in these states. The New York School of Dental Hygiene was founded by Louise C. Ball, who secured a grant of $2,500 from the Rockefeller Foundation, and with the aid of several dentists, physicians and teachers conducted a preliminary summer course through Hunter College in 1916. In the fall, the school became an organized part of the Vanderbilt Clinic of Columbia University. The course was a full academic year in length and required "evidence of attendance for one year in a high school" for admission to the class. This was the first university course for dental hygienists, and has been in continuous service since 1916. It is now conducted by the College of Dentistry of Columbia University.

In 1916, shortly after the New York school was founded, a similar school was established in the Rochester Dental Dispensary at Rochester, N. Y., under the direction of Harvey J. Burkhart, and another at the Forsyth Dental Infirmary for Children at Boston, Mass., under the direction of Harold DeWitt Cross. These schools have since become a part of the School of Medicine and Dentistry of the University of Rochester, and of the Dental School of Tufts College, respectively.

From the time of the establishment of the first training schools, the dental hygienist movement has made rapid progress. At the present time, there are ten schools: Training School for Dental Hygienists, University of California, San Francisco, Calif.; Courses in Oral Hygiene, School of Dentistry, University of Pennsylvania, Philadelphia, Pa.; School for Oral Hygienists, Temple University, Philadelphia, Pa.; School of Dental Hygiene, Marquette University, Milwaukee, Wis.; Dental Hygienist School, Northwestern University, Chicago, Ill.; School of Dental Hygiene, College of Dental Surgery, University of Michigan, Ann Arbor, Mich.; School for Dental Nurses, University of Minnesota, Minneapolis, Minn.; School of Oral Hygiene, Columbia University, New York City; School for Dental Hygienists, University of Rochester and Rochester Dental Dispensary, Rochester, N. Y.; and Forsyth-Tufts Training School for Dental Hygienists, Boston, Mass.

The dental laws in the following twenty-six states have been amended to regulate the practice of dental hygienists: Alabama, Arkansas, California, Colorado, Connecticut, District of Columbia, Iowa, Louisiana, Maine, Massachusetts, Michigan, Minnesota, Mississippi, New Hampshire, New York, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Vermont, Washington, West Virginia, Wisconsin, and Wyoming and the Territory of Hawaii.

In the majority of these states, the hygienists have organized into local or state societies. The dental hygienists of California were instrumental in bringing the matter of organizing a national dental hygienists' association to the attention of the Officials of the American Dental Association at a meeting in Los Angeles, Calif., in July, 1922. A resolution was presented and met with the approval of the Board of Trustees, and, Sept.

12, 1923, the American Dental Hygienists' Association was formed, in Cleveland, Ohio. The first officers chosen to serve in this new organization were Mrs. Hubert W. Hart, Bridgeport, Conn., president; Miss Edith Hardy, Rochester, N. Y., president-elect, Miss Evelyn C. Schmidt, Boston, Mass., Miss Emma Ditzell, Harrisburg, Pa., and Miss Ethel Covington of Denver, Colo., vice-presidents, Miss Helen Hilbish, Cleveland, Ohio, treasurer, and Miss Alma W. Platt, San Francisco, Calif., general secretary.

The American Dental Hygienists' Association is sponsored by the American Dental Association, and has held its convention in conjunction with the Annual Session of the American Dental Association. It is estimated that there are approximately 2,000 dental hygienists in the United States at present, with the number increasing yearly, as the various training schools graduate their classes.

Without doubt the work of these auxiliary practitioners of educational and preventive dental service constitutes one of the greatest contributions of dentistry to the public's health during the past twenty years, in which time the dental hygienist movement has developed to its present importance.

DENTISTRY AS A HEALTH PROBLEM*

By EVELYN C. SCHMIDT, Chicago, Illinois

DENTISTRY as a health problem is often discussed in somewhat the following manner: From 75 to 95 per cent of the children in the public schools have decayed teeth. Dental caries is not only the most common of all physical defects among school children, but it also outnumbers all other defects combined. From 30 to 65 per cent of all children who are otherwise normal have defective teeth. In the first selective draft, dental defects ranked second among all causes for rejection. Nervous disorders and general systemic conditions are frequently traceable to the mouth. And so on, *ad infinitum*.

In the presence of such facts, statistics and data need not be stressed in order to prove that dentistry is a health problem. It is accepted not only that it is one, but also that it must be approached broadly, and that the dental profession must work with well-established organizations already active in the field of public health and preventive medicine. It is essential to look at a cross-section of the dental problem in order to discover the cause for existing conditions and what, in the light of present-day knowledge, seems the expedient and feasible approach to their diminution. That these conditions are claiming the attention of official health bodies, which are the legally constituted agencies of health within a given territory, is proved by the fact that twelve states have full-time dental workers associated with the board of health or board of education and that ten states have dentists as members of, or serving in an advisory capacity to, the board of health.

That state dental societies are inter-

*Read before the Michigan State Dental Society, April 14, 1926.

ested in the problem is shown by the fact that twenty-four states have committees on mouth hygiene and public instruction. These data were obtained from a recent questionnaire sent to the secretary of every state dental society. Thirty-three states reported that they had committees; eleven reported that they did not, and from the other states there have been no replies as yet. In some instances, the committees on mouth hygiene are more or less nominal; in others, they are very active. For example, in Texas, Indiana, Pennsylvania and Mississippi, state committees on mouth hygiene have sponsored state-wide dental health weeks which have been very successful. By successful, I mean not only that their publicity was good during the week, but also—and far more important—that the dentists became genuinely interested in preventive dentistry and community dental health week, and so helped develop permanent programs in their locality.

From a public health point of view, what are the problems that the dental profession is facing? Time will not permit many divisions. We will, therefore, consider lay education, and follow-up dental service.

LAY EDUCATION

As far as education is concerned, it is true that nothing can progress any faster than the minds of the people allow, but it is also true that the masses are not only interested in health but are even demanding to know from both the medical and the dental profession why there is so much tuberculosis, so much cancer, so much tooth decay, so much focal infection, and what they can do, as individuals and as citizens with a social responsibility to their community, to improve conditions. Society is eager for health education. The dental profession has a responsibility to teach people the truth. I say "the truth," for the profession must first of all be iconoclastic, and then *build up* with truth. The public is gullible. It accepts readily statements and advertisements that are plausible but not necessarily truthful. The scientific pen must attack fadists and biased advertisements if the span of life is to be lengthened and dental health conditions improved. Some people argue that this should be done by the methods that the advertiser and the commercialist use; namely, that space should be rented in newspapers to carry on truthful dental health propaganda. This question was discussed last year by the American Dental Association, and it was voted not to commercialize the profession in this way, but to prepare material which could be offered and used when desired. There seems to be no difficulty about placing educational material in newspapers, showing motion pictures and broadcasting, if the identity of the individual is submerged.

Lay education must not only counteract the fadist and exaggerated advertising: it must also break down the pernicious adages that have been handed down from generation to generation. Intelligent people still glibly remark, "Well, you know the old saying, 'A tooth for every child,' " or "They're just baby teeth," or "False teeth were good enough for my father and they're good enough for me."

Within the profession, there are problems in connection with lay education also. Perhaps the greatest is the utter indifference of a large proportion of the men to the educational phase of

dentistry, the calm disinterest with which they regard any aspect of their profession other than the technical. There is the lack of uniformity of teaching that makes the lay person wonder and question. For instance, a given dentist or group of dentists, or we might even go so far as to say the dentists in a given area, advocate that all pulpless teeth be extracted. In another district, we find most of the men opposed to this. What is the intelligent lay person to deduce? Take the simple question of brushing. A public health worker once said to me, "How can the dental profession expect to strengthen its lay education until it agrees within itself about such a simple thing as how to brush the teeth? I have recently been in three states. In the first state, I asked some of the leading men what method they advocated. They replied that one should always use the rotary motion, otherwise the gums might be injured, and so on. In the second state, in answer to a similar inquiry, the men said that the vibratory method was the only one to use; any other manner of brushing might do inestimable harm to the mouth. In the third state, the comment was that there was only one safe method and that was to brush down on the upper teeth and up on the lower teeth with the jaws apart. As a result I have gone back to my state and am teaching people to brush up and down, 'round and 'round, and in between, hoping thereby that some of the harm of some of the methods will be counteracted by some of the good of the others." My plea for lay education is, therefore, first of all, interest and a feeling of responsibility on the part of the dentist, and next, an attempt to standardize the information to be given to society. The question of individual instruction that is given in the office of the dentist is another matter.

FOLLOWUP

If people were to follow the advice that we are giving as to the fundamentals of preventive dentistry, and were to take their children to a dentist every three or four months, beginning at the age of 2½ years, and if they themselves were to go every six months, what problem would the profession be facing? Is it not beginning to face it now? Are we not hearing, in connection with school community programs, for instance, that it is impossible to develop a followup of an educational program, for these reasons:

1. There is a lack of adequate dental service. If we accept the statement that there should be one dentist for every thousand, only three states are provided for. Even if there were one dentist for every 1,500 persons, which some feel would be adequate service, only ten more states could be added. This means that only thirteen of the forty-eight states have service which could be considered commensurate.

2. Rural communities present a problem of inadequacy of dental service and of the necessity of supplying this at a nominal cost.

3. Many dentists refuse to work on children because they are pressed for time or because "the first teeth are unimportant."

4. The cost of good dental service is prohibitive to a large proportion of the population.

As far as the inadequacy of dental service is concerned, this problem will have to be solved entirely within the profession, partly by the dental schools and partly by the dental hygienist,

whose work will supplement that of the dentist and who will be employed primarily in schools to emphasize the educational and prophylactic phases of the dental problem. Several states are recognizing the need for the hygienist and are introducing legislation that is worthy of attention. In New York State, the educational system allows state aid in an amount not to exceed $700 as one-half the salary of a dental hygienist to be employed in school work. In Pennsylvania, where there are about 150 dental hygienists now employed in school work, there is a similar law, as well as one that compels every dental hygienist to spend eight months in public health work before entering private practice. I am citing these examples to show the general trend of the public health phase of dentistry; namely, that states are recognizing the fact that there are not enough dentists to carry on both reparative work and a dental public health program; that the dental hygienist has a place in the program, but that often there must be legislative measures passed during this embryonic stage of her existence that will encourage communities to employ a dental hygienist and will make the work in the field of public health remunerative enough to encourage girls to enter it. New Zealand, confronted with the same problem, has gone a step farther in the solution by training girls in government schools to do educational work, give prophylactic treatments, and fill deciduous teeth and the first permanent molars. These girls work in schools only.

The school nurse and school teacher also must receive better instruction in dental health to help solve the problem. Every training school for nurses and normal school for teachers should have a course of instruction.

The rural problem is difficult to solve, for it combines the question of inadequacy of service with inaccessibility to dentists. Often, there are many towns in which there is no dentist and from which it is difficult to reach one. For this reason, the traveling dental clinic is becoming more common. An added problem arises here, for, even if an organization is willing to establish and conduct a clinic, it is often difficult to secure a dentist who will divorce himself from the metropolis. This condition prevails likewise in the medical profession. An interesting solution has been found in the town of Altura, Minn. The citizens decided to form a health association for the purpose of employing a capable doctor by contract. He was secured under the following plan: The association agrees as a salary guarantee to secure as many members as possible on the basis of $24 a year for each family, the doctor to have entire freedom for outside practice after meeting the claims of members to his services, which include any needed calls in case of sickness, a thorough health examination twice a year and sanitary inspection of the home, including inspection of the water supply, drainage and garbage and sewage disposal. Could not the dental schools *not* merely suggest that men go into rural communities, but work out a plan to show them how they could earn a good livelihood and be an integral part of the community life?

The third question—that of the dentist's refusal to work on children—must, of course, be settled by the profession.

The fourth question; namely, that we are educating people to seek an ethical dentist, but that good dental service is prohibitive in its cost to a large proportion of the population

seems to be having a direct effect on the attitude of society. In a recent article by Dr. George E. Vincent on "The Doctor and the Changing Order," there is the following statement: "It looks as if society means to insist on a more efficient organization of medical service for all groups of people, upon distribution of the cost of sickness over large numbers of families and individuals and upon making prevention of disease a controlling purpose. Just how these ends will be gained, only a very wise man or a very foolish man would venture to predict. One thing seems certain: in the end, society will have its way."

I am not wise enough and I hope not foolish enough to try to discuss with you, in other than an interrogatory way, Dr. Vincent's remark, to see if it is applicable to dentistry. Are there not, however, many indications that society is becoming educated to the point where it desires good dental service and where it means to insist on a more efficient organization of dental service for all groups of people, with a distribution of costs and with prevention as a controlling purpose? Let us cite a few examples: In New York City, there is an International Ladies' Garment Workers' Union. While the people employed in making women's garments receive a fair wage, they cannot afford to pay for first-class dental work, especially if they have a large family. Their leaders had been educated to know that quack dentistry is undesirable; that the unethical dentist and the charlatan of medicine are to be avoided. What was the solution? Five years ago, the members of the Union bought a building in which to house a health center and equipped it at a cost of $90,000. This health center is under the direct control of the members of the Union. Since its establishment, 66,000 members have received thorough medical examination and advice. When the health center was established, two dental chairs were installed. The demand for service soon ran so far beyond the capacity of the initial equipment that the Union has recently opened a special dental department with twenty-four chairs and with a staff so excellent that the most meticulous person could recommend it. Thus, a large number of people are given an excellent service at a cost of from $4 to $5 an hour, and with no suggestion of paternalism, since the clinic is managed and financed by the people themselves. Thus, one group is solving the dental problem by itself.

Industrial and commercial establishments present another interesting aspect of the problem of supplying dentistry to the masses at a price within their reach. A group of industrial organizations recently reported that from 60 to 90 per cent of their employes showed the need of dental treatment, and that some of this group needed definite and immediate attention in order to improve their health and preserve their earning capacity. No one, of course, would dispute the fact that people in industry need dental service. What has been done about this and what are the indications for the future? The War served as an excellent stimulus for the introduction of dental service into industry. Stripping the facts of all sentiment and altruism, we know that many plants introduced welfare and health services, or enlarged those that already existed, in order to keep as much capital as possible within the organization during industrial inflation. Regardless of what the underlying motive may have been, the fact remains

that dental service has been proved an economic asset to an industrial plant in normal times, since most of the clinics have continued to function, or new clinics have been established to make up for discontinued ones; so that now there are in the United States about 110 plants known to have dental service. Sometimes, the expense is borne entirely by the firm, in which case not only the expense of the treatment but also the employes' time is contributed. Sometimes, the employes pay for the material used. Some companies offer only emergency treatment and refer the patients to private dentists or to clinics connected with dispensaries or health centers for further care; others offer complete dental service to those requesting it; while still others require the employes to have their teeth examined, clinically and by roentgen ray, and properly cared for, as well as checked periodically either by the factory clinician or a private dentist. The firms are invariably enthusiastic about the benefits to the employes, since the service is an economic asset to them. Whereas, one-half day is ordinarily lost when an employe goes to the dentist, which means that the machine is idle for that length of time and hence there is less production, a visit to the plant dental clinic takes only from thirty to forty-five minutes. All of this means more dividends to stockholders; but many public health workers object to this type of service, feeling that it is paternalistic, and not conducive to the highest morale among workers. How, then, is this problem being worked out? Here, again, we are finding that, within the last few years, many mutual benefit societies in industry are managing the dental service themselves, thus giving the members of their society a type of service at a cost which would be impossible under any other circumstances, and there is nothing to suggest paternalism or charity about this type of service.

Dental service in department stores is another outgrowth of the fact that the average person cannot afford good dentistry, and that health education is leading them away from the advertising man. In the East, many stores are establishing dental service. In some instances, it is purely educational and prophylactic, with examination included. Under these circumstances, it is conducted by the store itself. In other instances, complete dental service is available to members of the mutual aid association. With a lessened overhead expense, supplies bought in large quantities and no time lost by cancellation, a good type of dentistry is given store employes for $3.75 an hour.

Many dentists object to any form of industrial dental service. However, the attitude of the dental profession is changing. While many men call this type of service "advertising," this statement merely camouflages the feeling that the service is taking patients. Many more dentists are realizing that the industrial dental clinic, because of its educational influence, is increasing the number of patients in the family of the employed, and is leading people away from the offices of the cheap advertising quack, to the ethical dentist. Does all of this not suggest that society means to insist on a more efficient organization of dental service, as well as of medical service, for all groups of people, on distribution of the costs of sickness over large numbers of families and individuals?

The industrial field offers an excellent opportunity for the dentist. Here is a large group of individuals under strict supervision and control, whose habits can be studied *en masse* and singly, so that the opportunity is offered for obtaining statistical information that cannot be duplicated.

Hospitals also are beginning to recognize that the majority of their patients are in need of dental service, although they have been rather slow to avail themselves of the services of the attending dentists. There is, however, in New York, one hospital which demands that every patient admitted have a prophylactic treatment before any work is done. In many other hospitals, there is dental service offered, especially in connection with the outpatient department. This is another means of supplying much needed service to a certain group.

For the dentist, the hospital dental service offers an excellent opportunity, for the dental intern can absorb the medical aspects and at the same time emphasize the importance of dentistry in connection with medical work.

In health centers to which the expectant mother, the preschool and the school child come, a dental service is of inestimable benefit in teaching the value of the care of the teeth of the expectant mother and of the preschool child, and of linking up this teaching with dietetic instruction. In this type of clinic, the endeavor should constantly be made to teach dental hygiene rather than to carry on reparative work, for a health center has, as its ultimate goal, to keep well babies well, and to grow sound teeth. Its vision is concentrated on the coming generation, rather than on the present.

The receptivity and vision of the dental profession is being tested. By keeping its ear to the ground, the profession will hear the deep, distant rumble of public sentiment, making its demands and will have to shape its policies and assume its responsibilities accordingly, if it wishes to be on a high plane of service, and make its appeal to the intelligent classes of society.

ASSOCIATION OF STATE DENTAL DIRECTORS

During the Seventh International Dental Congress, two luncheon conferences of state dental directors and others interested in dental public health were held. An association of state dental directors was organized, members of which are full-time state dental directors. At the Detroit meeting, luncheon conferences will be held to which any one interested will be invited.

FIELD NOTES*

The chairman of the Committee on Mouth Hygiene and Public Instruction of the Kentucky State Dental Society called a meeting of the subchairmen of eleven component societies, to which all responded. Plans were developed whereby each subchairman is to sponsor and organize dental surveys in the schools in his district and to organize followup work in the form of clinical service for indigent children and an educational program for all.

As the result of a survey at the Columbus School, Oklahoma City, Okla., which showed that 90 per cent of the pupils needed dental work, a carnival was given to raise money for clinical service. The sum of $150.00 was contributed, and the local dental society has managed, with the aid of the principal of the school, to hold a clinic for those needing dental care.

*The Department of Dental Health Education will be glad to receive items of news along the lines of education in dental or general health.

Medical and Dental News

Florida

Florida State Dental Society Elects Officers: Following are the newly elected officers of the Florida State Dental Association: president, L. W. Knight, Jacksonville; president elect, F. L. Adams, Tampa; first vice president, C. J. Masters, Jacksonville; second vice president, H. G. Bow, Deland; chairman of postgraduate work, C. J. Carballo, Tampa; editor of *Bulletin*, Alton B. Whitman, Orlando; librarian, A. W. Sears, Jacksonville; secretary-treasurer, C. C. Stewart, St. Petersburg. The next meeting will be held in St. Petersburg, in October, 1927.

Georgia

Eighth District Dental Society Meets: The Eighth District Dental Society met October 7, at Athens, Ga. W. A. Clarke, of Atlanta, spoke on "Orthodontics," and Miss Catherine Newton on "Studies in Nutrition." J. Russell Mitchell, Atlanta, president elect of the state dental society, spoke on "Dentistry of Today" at the banquet given at 6:30. Harold DeWitt Cross, of Boston, Mass., spoke in the evening on "Preventive Dentistry for Children" and W. A. Sutton, of Atlanta, spoke on "The Importance of a Dental Program in the School Life of a Child." Dr. Cross, assisted by S. J. Ware, Athens, also gave a clinic on "Dentistry for the School Child," in the afternoon.

Illinois

Joint Meeting of Dental Societies: The first joint meeting of the Madison County, St. Clair District, Southern Illinois and Wabash River component societies was held at Mt. Vernon, October 13-14. O. W. Brandhorst, St. Louis, spoke on "Orthodontia in General Practice;" F. F. Molt, Chicago, on "Mouth Preparation, Surgical, for Dentures;" William F. Wahlen, Peoria, on "Good Fellowship—What It Means to Our Success and the Advancement of Our Profession;" J. M. Hale, Mt. Vernon, on "Taking an Upper Impression with Rolling Ridge in Front; Technic to Obtain Maximum Retention and Stability in Lower Impression;" G. B. Winter, St. Louis, Mo., on "Operative Technic in Impacted Mandibular Third Molars, the Results of Ten Years' Research," and W. E. Harper, Chicago, on "Amalgam Technic."

Dr. Kells Honored: A testimonial dinner in honor of C. Edmund Kells, of New Orleans, La., was given by the Odontographic Society of Chicago, on Dr. Kells seventieth birthday, October 21, in the Grand Ball Room of the Hotel LaSalle, Chicago. D. C. Bacon, president of the Society, presided, and Hart J. Goslee acted as toastmaster. The principal speaker of the evening was A. C. Fones, of Bridgeport, Conn., who spoke on "The Dental Hygienist." Otto L. Schmidt, M.D., Chicago, also spoke on "A Bit of History of the Roentgenogram." Tributes to Dr. Kells were given by Drs. Banzhaf, Patterson, Knapp, Simpson, McAfee and Gallie and Mervin B. Massol.

Dr. Belfield Honored: Members of the medical and dental professions of Chicago met, October 23, at a banquet in honor of William T. Belfield, for many years professor of bacteriology at the Chicago College of Dental Surgery. C. N. Johnson, of Chicago, and Hugh Young, of Baltimore, Md., were the principal speakers of the evening.

Millions to U. of C. for Medical School: A contribution of $3,385,000 from the general education board of New York for a new medical school on the campus of the University of Chicago was recently announced. An additional gift of $2,000,000 must be secured for the endowment fund

before the original gift becomes available. The tentative program calls for a children's clinic, with provision for hospital care for at least 100 children; a lying-in hospital and gynecologic clinic; a psychiatric clinic, a hospital for infectious diseases and an orthopedic clinic. Medical buildings on the university campus already cover two blocks, providing laboratories and a hospital and clinic. The work of Rush Medical College, a part of the university, will be supplemented by the work of the new medical units.

Michigan

First District Dental Society Meets: The first fall meeting of the First District Dental Society was held in Detroit, October 14. The general subject discussed was preventive dentistry, the program being under the direction of Grace Rogers Spalding, of Birmingham. The clinics were presented under two heads: dentistry for children, and preventive dentistry and orthodontia. At 6:30 p. m., a dinner was given in honor of Henry L. Banzhaf, president of the American Dental Association, and Otto U. King, general secretary of the Association, at which Grace Rogers Spalding spoke on "Facts, Not Fads, Pertaining to Preventive Dentistry." The First District Society announces plans for a "sequence of meetings covering as many phases of dentistry as possible in the form of a real extension course covered by lectures, clinics and debates, using local talent as often as the committee consider it as good or better than can be imported from other states. The reasons being: 1. To develop teachers among our own members. 2. To control our programs in such a way that our members may get the greatest practical benefit by attending the full course of meetings. 3. To eliminate all lecturers who love to promote fantastic theories without sufficient research upon which to base their teachings. 4. To demonstrate to other dental societies fundamental principles for building a program for a series of meetings. 5. To gain the whole hearted support of our members."

New York

Scientific Conference at Rochester: A scientific conference, marking the opening of the schools of dentistry and medicine of the University of Rochester, was held October 25-26, being opened with a public meeting in the Eastman Theater, addressed by John Campbell Merriam, president of the Carnegie Institution of Washington. Those reading papers at subsequent sessions were Ludvig Hektoen, Chicago, who spoke on "Recent Investigations in Scarlet Fever, Measles and Tuberculosis;" Joseph Erlanger, St. Louis, Mo., who spoke on "Analysis of the Action Current of the Nerve;" Friedrich Muller, Munich, who presented a paper on "The General Pathology of Joint Diseases;" Theobald Smith, Princeton, N. J., who spoke on "Immunity, Natural and Acquired, as Illustrated by Experiments with Bacillus Coli and Its Mutants;" and Lewis Hill Weeds, Baltimore, Md., whose subject was "Problem of the Relation of the Muscle and Nerve." Clinics were given by Prof. Muller and Harvey Cushing of the Harvard Medical School.

Ohio

Cleveland Society Meets: The Cleveland Dental Society held its first meeting of the fall and winter season, October 4, with M. B. Rudd of Richmond, Va., as the principal speaker of the occasion.

Oklahoma

Eastern District Society Meets: The Eastern Oklahoma District Dental Society met, November 2-3, at the Severs Hotel, Muskogee, in annual session. The first day was given up to registration, a business meeting, a banquet and an illustrated lecture on the removal of impacted lower third molars by George B. Winter, St. Louis, Mo. In the evening, R. N. Holcombe, M.D., Muskogee, Okla., spoke on the "Relation of Focal Infections of the Mouth to Systemic Diseases," and reports of the Congress at Philadelphia were made by those who attended. The second day was given up to a comprehensive program of clinics.

Texas

New Department at A. and M. College: A department to be known as the Division of Rural Home Research has been opened at the Texas A. and M. College, with Dr. Jessie Whiteacre, of the University of Chicago, in charge. Dr. Whiteacre has done similar work in Utah and Ohio. One of the principal subjects to be investigated will be the relation of the diet to oral conditions.

Washington

Honored with Life Memberships: At the October meeting of the King County Dental Society, at Seattle, a banquet was given for

seven members, who had given twenty-five years' service to the Society, the following being thus honored and presented with life membership diplomas: Frank I. Shaw, Eben B. Edgers, George M. Freeman, George Kimball, F. E. O'Connell, J. F. Wagoner and Frank Smith.

Foreign

Education of Dentists: Recently, the ministerial decree on the education of dentists in Czechoslovakia was promulgated. According to the decree, an institute for the education of dentists is being organized in Prague under the ministry of health. The direction of the institute is in the hands of a director, who at present is professor of dentistry at the medical faculty. The institute is subdivided into a number of departments, with a chief at the head of each. To qualify as a dentist, one must successfully pursue the regular curriculum at the institute. Only doctors of medicine can be accepted as candidates. The time of training at the institute is ten months, and those who successfully negotiate it are entitled to a special certificate. Those who have been assistants at some of the Czechoslovakia dental clinics for at least nine months can obtain the certificate after one month's stay at the institute.—Prague letter, *J.A.M.A.*, Oct. 9, 1926.

General

Sixty-Ninth Session of A. D. A.: The sixty-ninth annual session of the American Dental Association is to be held in Detroit, Mich., Oct. 24-28, 1927.

Local Arrangements Committee for Next Session of A. D. A.: The following have been appointed to serve on the Local Arrangements Committee at the Sixty-Ninth Annual Session of the American Dental Association, to be held in Detroit, Oct. 24-28, 1927: chairman, Charles Lane; secretary-treasurer, W. F. Northrup; local chairman on commercial exhibits, R. E. Patterson; publicity, Patrick J. O'Reilly; halls and hotels, William T. Burke; health exhibits, A. C. Thompson; information and registration, E. O. Gillespie; entertainment, O. W. White; clinics, Edgar L. Giffen; reception and transportation, Harry T. Wood.

Chairman of Clinics Appointed: R. L. Sprau, Louisville, Ky., has been appointed chairman of clinics for the Sixty-Ninth Annual Session of the American Dental Association.

Army

Dental Corps: Maj. Chester Denham, relieved Fort Howard; detailed at Northwestern University Dental School, Chicago.

Capt. W. D. Vail, assigned Madison Barracks, N. Y., effective upon completion tour of foreign service.

1st Lieut. J. M. Epperly, relieved Fort Hamilton; assigned Philippine Department, sailing from New York, March 8.—*Army & Navy Register,* Oct. 9, 1926.

Navy

Dental Corps: Changes in stations and duties of officers of the Navy dental corps will be made as follows: Lieut. Ray E. Farnsworth from navy yard, Puget Sound, Wash., to U. S. S. Nevada; Lieut. Edward A. Hyland from naval station at Guam to naval training station, Newport, R. I.; Lieut. Andrew L. Burleigh from U. S. S. Altair to New York navy yard; Lieut. Clarence A. Chandler from naval training station, Hampton Roads, Va., to U. S. S. Texas; Lieut. John W. Grassl from naval hospital Norfolk, Va., to U. S. S. Arkansas; Lieut. Joseph W. Baker from naval training to naval air station at Hampton Roads, and Lieut. Leon M. Billings from marine barracks, Parris Island, S. C., to naval hopsital, Mare Island, Calif.

The following recently found qualified for appointment to the Navy dental corps, upon acceptance of commissions and execution of oaths of office as assistant dental surgeons, will be assigned to duty as follows: Lieut. Ray D. Pitton, Denver, Colo., to naval training station, Hampton Roads; Lieut. Alvin F. Miller, Boston, Pa., to naval training station, Newport; Lieut. Clifford T. Logan, Omaha, Neb., to naval training station, Hampton Roads; Lieut. James L. Purcell, Washington, D. C., to New York navy yard; Lieut. Eric B. Hoag, Manchester, Iowa, to naval training station, Hampton Roads; Lieut. Ralph W. Malone, Durham, N. C., to marine barracks, Parris Island, and Lieut. Herman P. Riebe, Berkeley, Calif., to naval training station, Hampton Roads, via first available Government transportation.—*Army & Navy Register,* Oct. 16, 1926.

Deaths

Burne, Alfred, Waverley, New South Wales; died, September 26. Dr. Burne graduated in dentistry in the United States and had practiced for more than fifty years. He retired four years ago. He was a former

lecturer in prosthetic dentistry at the University of Sydney, president of the first Australian Dental Congress, past president of the Society of Dental Science, Sydney and an ex-member of the dental board.

Holmes, W. R., Macon, Ga.; New Orleans Dental College, 1874; died, September 23, after a year's illness. Dr. Holmes had practiced in Macon for fifty years.

Mahoney, E. J., Ashland, Wis.; Marquette University, School of Dentistry, 1918; died, May 5.

Morrison, William J., Nashville, Tenn.; University of Tennessee College of Dentistry, 1882; died, October 27, from paralysis. Dr. Morrison was a former president of the state dental association and an author and inventor.

Mummery, J. Howard, London, England; died suddenly, August 30, while on a holiday at Cornwall.

Offill, William A., Chicago, Ill.; Northwestern University Dental School, 1911; died, July 17, at Evansville, Ind.

Peirce, George H., Boston, Mass.; Tufts College Dental School, 1878; died, July 16; aged 78. Dr. Peirce had practiced dentistry for nearly fifty years.

Phillips, John A., Butte, Mont.; George Washington University, Dental Department, 1907; died, April 22.

Piper, Charles Nahum, Boston, Mass.; Boston Dental College (Tufts), 1892; died, August 17, of heart disease.

Ray, Claude F., Milwaukee, Wis.; American College of Dental Surgery, Chicago, 1890; died, July 4; aged 56.

Reece, Robert W., Mount Airy, N. C.; Baltimore College of Dental Surgery, 1890; died, July 15, after a long illness.

Roddy, Willard A., St. Louis, Mo.; Washington University School of Dentistry, 1888; died October 15, of septic pneumonia; aged 61. Dr. Roddy was a former president of the state board of dental examiners of Missouri.

Rusco, George Byron, West Bend, Wis.; Northwestern University Dental School, 1900; died, October 23, after an illness of three weeks; aged 52.

Schiller, Victor R., Chicago, Ill.; Chicago College of Dental Surgery, Dental Department of Loyola University, 1900; died recently; aged 46.

Scott, Walter M., Columbus, Ohio; Ohio College of Dental Surgery, Dental Department of the University of Cincinnati, 1901; died recently; aged 49.

Smedley, William, Denver, Colo.; Pennsylvania College of Dental Surgery, 1866; died, October 28, of pneumonia; aged 90. (A more extended notice of the life and works of Dr. Smedley will appear in the January issue of THE JOURNAL.)

Stone, J. C., Tullahoma, Tenn.; died, July 8; aged 58.

Vivian, John T., Washington, D. C.; George Washington University, 1907; died, August 10.

Waldrop, O. Stanley, Kinston, N. C.; Baltimore College of Dental Surgery, 1917; was killed in an automobile accident, July 4; aged 31.

Weymouth, J. H., Elkins, W. Va.; died, June 28; aged 82. Dr. Weymouth was a captain in the Confederate Army during the Civil War.

Whinnery, Cassius E., Salem, Ohio; Tufts College Dental School, 1889; died, August 12; aged 69.

Winkler, William C., Indianapolis, Ind.; Indiana University School of Dentistry, 1919; died, July 7; aged 32.

Wogan, Charles E., Carlisle, Pa.; University of Maryland, School of Dentistry and the Baltimore College of Dental Surgery, 1890; died, June 25; aged 58.

CURRENT LITERATURE

EXTRACTS AND ABSTRACTS

Effect on Visual Acuity of Viewing Motion Pictures: In a series of tests as to the effect on visual acuity of viewing motion pictures, A. R. Irvine and M. F. Weyman (*J.A.M.A.*, Oct. 2, 1926) found that there was a greater fall in acuity after forty-five minutes of reading than after viewing a motion picture for one hour and a half. When an experimental group viewed the picture immediately after the test that followed the reading period, 83 per cent who had shown a fall in acuity after the reading showed improvement after viewing the picture. Tests indicated that viewing technicolor pictures (pictures produced in natural colors) caused less fatigue than viewing black and white pictures, the conclusion being that objects in their natural colors are more easily identified.

Shall We Wait for Shock to Pass Before Operating?: Operation stops hemorrhage, relieves pain and suspense, minimizes the danger from sepsis, delayed shock and toxemia. Anesthesia relieves psychic shock. It will be said that even a slight additional trauma will add to the shock sufficiently to cause death. Candidly, I have never seen any evidence that proves this claim, and on the other hand, have had abundant experience to prove the converse. Personally, I have had scores of patients who came to operation in shock go off the operating table in much better condition than when they were put on the table and have never seen a death which could be rightfully charged to "operation during shock." On the other hand just what is to be gained by waiting for the shock to pass? Certainly delay is not a cure for hemorrhage or pain or psychic disturbance and just as certainly it does invite sepsis, delayed shock and toxemia. Certainly logic leads one inevitably to conclude that to delay operation because of shock is not sound surgery save in exceptional cases, and the writer's personal experience supports this conclusion. That the policy of delay is still so generally adopted is due in large measure perhaps to two arguments both of which are specious but unsound, viz.: 1. To operate in shock will bring surgery into disrepute by causing more deaths to be attributed to operations. 2. Owing to the present status of professional opinion the surgeon who operates during shock lays himself liable to blame . . . . The surgeon who operates during shock will quite often find it necessary to content himself with work which is not ideal and which may be incomplete. He is operating to save life and can well afford to leave the finishing of the work for a more opportune time . . . . Operation properly planned and wisely executed is the best form of treatment in many if not most cases of severe shock.—Miles F. Porter, in *J. Indiana M. A.*, Oct. 15, 1926.

Some Factors of Diet Influencing the Spread of Caries in Children: As a result of experimental work, May Mellanby and C. L. Pattison (*Brit. Dent. J.*, Oct. 1, 1926) have shown that food after absorption plays an important part both in influencing the calcification of teeth and in altering the reaction of erupted teeth to harmful stimuli. It was found that a fat soluble vitamin (D) promotes calcification and that a substance present in cereals, especially oatmeal, hinders calcification. A stimulus, such as friction with a file, resulted in producing much well calcified dentin when the diet had good calcifying properties and badly formed secondary dentin when the diet was poor in these properties. The present experimentation was carried out on children in an institution who were suffering from bone tuberculosis. The mouths of the children were charted and they were divided into three groups as nearly as possible on an equality as to age and general oral condition. The three diets differed in that one contained a large amount of the calcifying vitamin, the second contained much less, but a moderate amount of oatmeal in addition, and the third was intermediate between the other two as regards the amount of D vitamin content, but contained no oat-

meal. The teeth of the children in the first group were really in the worst condition; those in the second group, the best; this to make the test against the potency of the calcifying vitamin more stringent. The number of new carious teeth developing was least in the group fed on the best diet, greatest in the group receiving the intermediate diet. The spread of caries in teeth already carious followed on the same lines. An attempt was also made to test the degree of hardness or softness of the carious areas before special feeding was commenced and the results at the end were similarly noted. It was found that "hardening" of carious cavities occurred in the three groups in a similar ratio to the spread of caries.

Ocular Diseases of Dental Origin: Six cases of disease of dental origin are reported by H. C. Ezell (*J. Tennessee D. A.*, Oct., 1926). In case 1, the symptoms disappeared after removal of two upper impacted third molars. In Case 2, an abscessed and inflamed condition of the eyes subsided with removal of several abscessed teeth. An iritis (Case 3) was relieved by removal of an abscessed tooth. In Case 4, a bilateral iritis, with inflammation, lachrymation and photophobia, was found to be due to a markedly bad general oral condition with specifically a half dozen abscessed teeth. In Case 5, poor vision improved and areas of opacity in one eye were overcome by removal of two abscessed teeth, first and second upper molars. A return to normal vision in a case of pain, redness and impairment of vision was noted in Case 6 after removal of abscessed teeth. In every case, the possibility of any other source of infection was eliminated before removal of the teeth. In conclusion, the author stresses the importance of a thorough dental examination in searching for the cause of inflammatory eye diseases; the fact that the diseased teeth are usually found on the same side as the eye lesion; the importance of radiograms of the teeth; the fact that these films should be made by the dentist and studied with him; and the apparent fact that dental infection is a more frequent cause of eye disease than is commonly supposed.

Recurrence of Iritis as Influenced by the Removal of Infections: In a rechecking of fifty cases of iritis previously studied as to etiology and kinds of infection present, E. E. Irons and E. V. L. Brown (*J.A.M.A.*, Oct. 9, 1926) found no recurrence in forty-three cases after an observation period of from three to twelve years. In one case, there was, in addition to syphilis, a tonsillar condition and an alveolar abscess. The tooth was removed and antisyphilitic treatment given, but the tonsils were not removed, and recurrences were the result. In another, infected tonsils were responsible for repeated recurrences. In two cases, the source of the infection was gonococcal; in another a sinus was the offender. In a case in which tuberculosis of long standing, with tonsils and teeth infected, was considered responsible for the eye condition, there was recurrence in spite of removal of teeth and tonsils and treatment with tuberculin. The seventh case in which there was a recurrence did not offer adequate opportunity for study. In the forty-three cases of nonrecurrent iritis, the etiology was considered dental in ten cases, and in five other cases, the teeth may have shared the responsibility with other organs (tonsils, sinus, intestines). In seventeen cases, the tonsils were considered responsible for the eye condition, and they were involved in eight other cases. In the other cases, the infection was traced to syphilitic, gonococcal or tuberculous foci, or was ascribed to the presence of colitis, combined with infected conditions of the teeth and sinuses. The authors conclude: "As freedom from recurrence is an evidence of the etiologic relation of infections to iritis, this series emphasizes the importance of thorough examination and removal of infectious processes in iritis."

Administration of Nitrous Oxid-Oxygen for Extraction of Teeth: Respiration is the outstanding guide in every administration. Respiration is necessary to sustain life. Any irregularity in respiration is likely to react upon the heart in the same degree. However, in unusual cases, the heart may be failing while respiration is proceeding in an orderly manner. We are normally very sensitive to even the slightest obstruction to our breathing. It is obvious how exhausting it must be to a patient to pull for every breath with some degree of obstruction. Therefore, labored breathing occurring at any time during the administration should be immediately investigated. If due to minor conditions such as the throat being packed too tightly or to insufficient packing, allowing blood and mouth secretions to accumulate in the throat, or to nausea, to regurgitation of food, to falling

back of the tongue, or to improper operating position, the correction can readily be made and the operation continued. But if none of these conditions are responsible for the disturbance, to continue the anesthetic would be folly in the face of possible oncoming shock and collapse. To train oneself to listen for each inspiration and each expiration is not only an invaluable safeguard to the patient, but, furthermore, it is to me the first means of recognizing the instant when the surgical plane of anesthesia has been reached, and it is an adequate guide throughout the operation, if studied together with the pupillary signs and the muscular phenomena.—Emma Feichtinger, in *Iowa Dent. Bull.*, October, 1926.

Limitations of Nitrous Oxid-Oxygen Anesthesia: The limitations of nitrous oxid oxygen anesthesia as regards surgeon, patient and anesthetist are presented by L. A. Rethwilm (*Cur. Res. Anal. & Anes.*, Oct., 1926). The surgeon is forced to work more quietly and with as little manipulation as possible because relaxation is not complete, and cannot be unless an unnecessary amount of the anesthetic is given. While it is true that nitrous oxid-oxygen can be used for nearly all patients if enough oxygen is given to supply the patient's needs, in this case the nitrous oxid is insufficient to keep the patient asleep and relaxed unless operating is gentle and a local anesthetic is perhaps used. In the case of the anesthetist, greater skill and training are demanded than is the case in ether administration. The anesthetist must know how to interpret the patient's reactions and realize the futility of depending on mechanical rules and must be constantly alert to every change in the patient's condition. The anesthetist must be poised and self-controlled in order not to worry the surgeon unnecessarily, though warning him in case of need and asking his cooperation in obtaining relaxation.

"How to Keep the Men Alive": Something of much importance, and decidedly selective in its action, has happened in Denmark in the past fifteen years to improve the liklihood of survival of men between twenty and sixty years of age. There, as here, better housing conditions and easier working hours may have played a part in the picture but it is difficult to escape the force of the silent argument of statistics that this improvement in the health of grown men is directly related to a change in habits in the consumption of alcohol. In Denmark now, in contrast to the record of other countries, men have a chance equal to that of women for survival during the years of learning . . . . No one can give with certainty the complete or perhaps the only true interpretation of the relation between alcohol and longevity or alcohol and tuberculosis or venereal disease. In the United States, it will take at least a decade to disentangle truth from slander, to exclude propaganda and politics, to relearn to trust responsible opinion and the thoughtful judgment of the competent, and perhaps even then the confusion or racial and religious prejudices, the canker of bribery and bootlegging will have so deformed the social picture that pre and post prohibition experiences will still be incomparable. The more reason then to watch the relatively clear cut and experimental situations of our neighbors. While our social settlements, with sympathy and insight, are discovering the inner story of family experience among their tenement friends; while the heavy-footed professors of sociology are sorting and sampling throughout the United States with ponderous precision to learn the records of before and after in bank, shop, prison, health center and poor farm, it may well be that a clearer proof than any we can produce will come to us from over seas as in this simple truth from Copenhagen. If it is not reduction in alcoholic beverages which has brought the men of Denmark up to the level of vitality of her women, let us delve and search for the secret until we can secure equal benefits for ourselves. Is a half bottle of Bavarian beer all around the table worth the twenty-five minutes of life it costs to each of the family? Is the doubtful joy that goes with drinking a liter of spirits worth the half day (11 hours) of life sacrificed by each one in the community? Copenhagen thinks not.—Haven Emerson, in *Survey*, Oct. 15, 1926.

Tooth Extraction Cures Bell's Palsy: Knox and Minehart's patient had a typical and well marked palsy on the right side. (*U. S. Vet. Bur. M. Bull.*, Aug., 1926) Examination disclosed rather marked pyorrhea alveolaris, and an impacted lower left third molar. These three teeth were removed. Within two days after these extractions, the facial paralysis disappeared to a very marked extent. The cure was absolute, however, for the right side seemed weaker than the left

and at intervals pain was experienced in the seventh nerve at or near its exit from the skull. One week later, the right upper lateral incisor was removed because of extensive and deep infected pyorrhea pockets about it. Within four days, complete function had returned and pain was no longer felt in the seventh nerve. The paralysis has not recurred.—Abstr. *J.A.M.A.*, Oct. 2, 1926.

Pathology of Replanted Teeth: The presence or absence of the periodental membrane upon a replanted tooth has no appreciable effect upon the mode of attachment. Sections of teeth replanted under the two different conditions cannot microscopically or otherwise be distinguished from one another. Absorption seems to take place in a greater or less degree in all cases, the immediate cause being large multinucleated cells, osteoclasts. In certain portions of the root, the alveolar bone is found directly united to the root. This osseous union probably occurs at places where the root and alveolar bone came in close apposition. In other places attachment is obtained by ordinary scar tissue. In a small part, one finds an attachment by long connection tissue fibres markedly simulating the normal periodental membrane, and there being no absorption of the root at this place. Under ideal conditions, which I am unable to indicate, one could hope to obtain a like attachment throughout, which one could also assume would be as permanent as in the normal.—F. C. Wilkinson, in *Australian J. Dentistry*, Sept. 1, 1926.

Magnesium Chloride in Treatment of Papillomas in the Mouth: Fernandéz and Bigatti (*Rev. Méd. Latino-Americana*, June, 1926) report the complete subsidence of a number of minute papillomas on the mucosa of the mouth of a man, aged 34, after fourteen intravenous injections of a 40 per cent solution of magnesium chloride, to a total of 5.95 gm., in the course of a month. The amount injected was progressively increased from 0.05 to 1 gm. and was then suspended on account of intolerance. They urge a trial of this treatment before any operation or cauterization of rebellious papillomas and warts. Greco has been advocating them for nearly ten years.—Abstr. *J.A.M.A.*, Oct. 2, 1926.

Trigeminal Neuralgia of Dental Origin: Chiappori (*Semana Méd.*, June 24, 1926) analyzes the features which distinguish trigeminal neuralgia resulting from some unsuspected dental anomaly. In three cases described, removal of an unerupted wisdom tooth, or correction of pressure from false teeth, or removal of a fragment of a root broken off five years before, cured the neuralgia at one stroke.—Abstr. *J.A.M.A.*, Oct. 2, 1926.

Infraocclusion Produced by Orthopedic Treatment of Scoliosis: Two cases, from the Scottish Rite Hospital for Crippled Children in Atlanta, in which an infraocclusion of the molars and premolars was produced by the pressure upward of the plaster cast employed in the treatment of scoliosis are reported, with illustrations, by C. C. Howard (*Internat. J. Orthodontia*, May, 1926). The author says: "A method has been devised for the purpose of maintaining the relative position of the opposing teeth during the torso stretching process. A removable splint will be employed. This apparatus, adjusted to the maxillary and mandibular arches, can be removed by the attending nurse to allow a freedom of mastication and prophylactic care. This, or any other intraoral appliance, will not prevent a depression of the teeth nor a shortening of the lower one-third of the face. With the twelve anterior teeth, as added resistance, and creating a unit of all the teeth of each arch, it would follow that the shortening of the lower face would be materially decreased; and the deflection of the maxillary incisors and canines would be definitely checked. It is the opinion of the author that some 'open bite' cases are the result of a supraocclusion of the molars. It is only possible to arrive at a diagnosis by a study of facial length. Should the distance from the nose to the chin be definitely in excess of each of the upper two measurements, the open bite should not be closed by the downward movement of the maxillary incisors and canines, but a depression of the molars is indicated. A torso plaster cast should accomplish for the open bite created by a supraocclusion of molars in accord with the results produced as above described."

Oral Manifestations of Syphilis: Under the special manifestations of syphilis that are likely to come under the notice of the dentist in the ordinary routine of practice, F. W. E. Wagner (*Dent. Surgeon*, July 3, 1926) lists the superficial ulcers and skin rash characteristic of the secondary stage of laryngeal

syphilis, which may go on to deep ulceration involving the cartilages and vocal cords and threatening the life of the patient; primary chancre of the lips, resembling epithelioma, but smoother and flatter, and effecting the upper rather than the lower lip, with earlier involvement of the lymphatics beneath the jaw, and associated with mucous patches on the inner aspect of the lip and at the angle of the mouth; mucous patches and superficial ulcers of pharyngeal syphilis, which are followed by widespread thickening of the mucous membrane, progressing to ulceration and impeding respiration and swallowing; ulceration of the hard or soft palate, going on to involvement of the bone, leading to necrosis and perforation, which is indicated by an offensive discharge from the nose if the hard palate is affected and to a marked nasal accent when the soft palate is involved; and primary chancre of the tongue, with numerous small ulcerations of the mucous membrane of the tongue and mouth in the secondary stage. The deep syphilitic ulcer is not difficult to recognize, but the superficial ulcer must be differentiated from epithelioma. Epithelioma generally appears on the side of the tongue, attributed to the irritation of the bad tooth. There is a deposit of hard tissue at the base of the ulcer. The submaxillary glands are affected early, and the sore will spread to the floor of the mouth or the arches of the palate. With the syphilitic ulcer, there is absence of induration, and the glands effected are the posterior cervical. At first, the diagnosis is not easy in persons who have had primary and secondary syphilis; but, as the disease progresses, the presence or absence of other syphilitic symptoms will decide the matter. On the tonsils, there may be a primary chancre, with glandular enlargement. Secondary ulcers on the tonsils are almost universal, and are easily distinguished by the opaque whiteness of the surface. This sometimes supervenes at the edge of an ulcer on the tonsil; but more commonly there is no ulceration, simply the change of surface accompanied by some redness and swelling of the membrane, much soreness but little pain. The ulceration is usually symmetrical. In the tertiary stage, there is diffuse gummatous infiltration, involving the fauces and palate, progressing to pharyngeal stenosis.

Advantages and Disadvantages of Ethylene Anesthesia: In a discussion of ethylene as a general anesthetic, F. A. Aird (*Australian J. Dentistry*, April 1, 1926) summarizes the advantages as follows: (1) anesthesia is quick, without struggling, and little or no cyanosis; (2) relaxation is good—better than with nitrous oxid—and rarely is ether necessary, except in extreme cases; (3) there is absence of sweating (patients have a dry skin, and risk of pneumonia after long operations is almost completely obviated); (4) experience has shown that ethylene is ideal for patients suffering from diabetes, pulmonary tuberculosis and cardiac diseases from any cause. The disadvantages are: (1) odor, which one becomes accustomed to; (2) inflammability and explosibility—accidents have occurred, and therefore no naked flame or cautery must be near; (3) lack of portability, the apparatus being cumbersome and difficult of transport.

What the Educated Person Should Know About Health: 1. He should have a knowledge of the physiological basis for sound health habits, such as regular and sufficient hours of sleep, right posture, suitable exercise and proper elimination.

2. He should know the types and amounts and proportions of the various food elements essential to the proper nurture of his body.

3. He should have an acquaintance with the principles of normal mental action and the conditions underlying the more common variations from normal state of mind.

4. He should have a general understanding of the sex instinct in man—its stages of development, its normal expression and the values and penalties attaching to it.

5. He should have a knowledge of the factors determining infection and resistance and of the principles of artificial immunization in the case of certain of the common infectious diseases.

6. He should have enough knowledge of the causes and prevention of the degenerative diseases to offer a prospect of passing through middle life without a breakdown.

7. He should know and therefore be armed against health hazards lurking in the environment, such as polluted water and milk supply, congestion in housing, poisonous dusts of certain industries, infected soil, etc.

8. He should appreciate the necessity for frequent medical and dental examination.

9. He should have an intelligent basis for choosing wisely his medical and dental advisers, and for realizing that the modern

practice of medicine is grounded on science, and not on mystery, fancy and tradition.

10. He should have a knowledge of the important health problems facing the community, of the methods of attacking those problems, and of the results to be expected from intelligent community action in the public health field.—*Livingston Farrand.*

Sun Saves Indian Babies From Rickets: Although analysis shows Chippewa Indian babies have a higher percentage of physical defects than white children, and that variation between them in the incidence of rickets among the breast-fed babies is slight, in the case of artificially fed children rickets occurs with twice the frequency among whites as among Indians. This, it is suggested by the Minnesota State Department of Health, is due to the preventive effect of the greater exposure of Indian babies to direct sunlight. Minnesota's Child Hygiene Division has held, during the past two years, a series of infant and preschool clinics for children of the Minnesota Chippewa Indians, and two Chippewa Indian nurses have been employed to do maternal and infant hygiene nursing.—*Bull. U. S. Dept. Labor.*

An Unusual Medical Service: In August, 1925, the Bartow County (Georgia) Medical Society, under the inspiration of the Cartersville Rotary Club, carried on a scheme for examining and treating school children of Bartow County. Dr. Sam M. Howell, a member of the club, suggested to the Rotarians the need for this service. The county board of health, the auxiliary board and Dr. H. E. Felton, county health officer, cooperated. The boys' committee of the Rotary Club supervised the plans. Each Rotarian was assigned to two or more school districts in the county for the purpose of having the members of the auxiliary board of each district assist in arousing interest in the clinic and getting parents to bring in the children. All doctors, dentists and trained nurses in the county volunteered and gave their services. A considerable number of lay workers also were enrolled who furnished all needed machinery and supplies except ether, bandages and such things as were not available in ordinary homes. In two days, 763 children were examined. A public spirited citizen converted his home into a temporary hospital in which four operating tables and thirty-five beds were installed. One hundred and six children had their tonsils removed during two days, forty-eight children were fitted with glasses. One case of tuberculosis, twelve of hookworm disease and two of trachoma were discovered. More than four hundred children had teeth extracted. The work done by the doctors, dentists and nurses, if charged for at the regular rates, would have cost between ten and fifteen thousand dollars. No money was paid to anybody for services. The county board of health paid a few bills amounting to about a hundred dollars. Thus was staged one of the most practical and comprehensive public health demonstrations of which we have been informed. Great credit should be given to all who participated in this movement. The medical, dental and nursing professions should take pride in this demonstration of the altruistic ideals of their representatives in this section of the country. To some it may seem that there may have been those who should have paid for the service rendered, and this is probably true, but it seems to be evident that the scheme was carried on both as a demonstration as well as a public health measure and it is probable that the bread cast upon the waters will be found after many days.—*Boston M. & S. J.*, December, 1925.

Hemophilia in Dental Surgery: A case of diathetic hemorrhage which, by its persistence, incited the use of a great variety of popular measures of treatment is recounted by Park. The patient bled for nine days after the extraction of two teeth. Every known remedy for this condition was tried and failed. The quantity of blood lost each day was not great, but the condition had not apparently yielded to treatment. On the tenth day, however, the first signs of resolution of tissue in the socket were visible and a marked decrease in bleeding was observed. At this time, there was an anaphylaxis; the reaction of the serums the man had been given and the urticarial wheals which formed on his arms, legs and face gave him great discomfort. On the eleventh day the bleeding had nearly ceased and on the twelfth day entirely so, and the socket healed rapidly.—*M. Bull., U. S. Vet. Bur.*, abstr. *J.A.M.A.*

Announcements

CALENDAR OF MEETINGS*

NATIONAL SOCIETIES

American Dental Association, October 24-28, 1927, Detroit, Michigan.

American Society of Orthodontists, May 3-6, 1927, Chicago, Illinois.

Dental Protective Association of the United States, December 20, 1926, Chicago, Illinois.

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June inclusive.

December (1926)

Nevada, at Reno (4).
Ohio, at Columbus (7).

January (1927)

California, at San Francisco (24-28).

February (1927)

Minnesota, at St. Paul (23-25).

March (1927)

Louisiana, at New Orleans.

April (1927)

Alabama, at Montgomery (12-14).
Connecticut, at New London (28-30).
Kansas, at Topeka (18-20).
Kentucky, at Louisville (5-7).
New Jersey, at Newark.

May (1927)

Arkansas, at Hot Springs (9).
Illinois, at Peoria (10-12).
Indiana, at Indianapolis (16-19).
Iowa, at Des Moines (3-5).
Maryland, at Baltimore (2-4).
Massachusetts, at Boston (2-6).
Nebraska, at Omaha (16-19).
New York, at Buffalo (18-20).
Pennsylvania, at Pittsburgh (10-13).
South Dakota, at Sioux Falls (9-11).
Tennessee, at Memphis.
Texas, at Austin (10-13).
Vermont, at Burlington.
West Virginia, at Martinsburg (16-18).

June (1927)

Colorado, at Colorado Springs (15-18).
Georgia, at Albany.
Maine, at Rockland.
New Mexico, at Roswell.
Wyoming, at Thermopolis.

July (1927)

Porto Rico, at San Juan.
Wisconsin, at Milwaukee (12-14).

October (1927)

Florida, at St. Petersburg.

Chicago Dental Society, at Chicago, Illinois, January 26-28, 1927.

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

California, at San Francisco, December 4, 1926. Secretary, O. E. Jackson, 155 Kentucky Street, Petaluma, California.

District of Columbia, at Washington, D. C., January 10-14, 1927. Secretary-Treasurer, C. Willard Camalier, 406 Medical Science Building, Washington, D. C.

Iowa, at Iowa City, December 13-16, 1926.

Kansas, at Wichita, December 6-10, 1926. Secretary, George E. Burket, Kingman, Kansas.

Minnesota, at Minneapolis, December 13-18, 1926. Secretary, F. E. Cobb, 601 Donaldson Building, Minneapolis, Minnesota.

Nevada, at Reno, December 15, 1926. Secretary, C. E. Rhodes, Reno, Nevada.

New Jersey, at Trenton, December 6-11,

*Announcements must be received by the ninth of the month in order to be published in the forthcoming issue of THE JOURNAL.

1926. Secretary, John C. Forsyth, 148 West State Street, Trenton, New Jersey.

North Carolina, at Raleigh, January 10, 1927. Secretary, H. O. Lineberger, Raleigh, North Carolina.

Oklahoma, at Oklahoma City, December 27, 1926. Secretary-Treasurer, Charles A. Hess, Idabel, Oklahoma.

Pennsylvania, at Philadelphia and Pittsburgh, December 6-9, 1926. Secretary, Alexander H. Reynolds, 4630 Chester Avenue, Philadelphia, Pennsylvania.

Rhode Island, at Providence, December 14-16, 1926. Secretary, Albert L. Midgley, 1108 Union Trust Building, Providence, Rhode Island.

South Dakota, at Sioux Falls, January 3, 1927. Secretary, G. G. Kimball, Mitchell, South Dakota.

Texas, at Dallas, December 6-9, 1926. Secretary, D. C. Johnson, Atlanta, Texas.

CALIFORNIA STATE DENTAL ASSOCIATION

The next annual meeting of the California State Dental Association will be held Jan. 24-28, 1927, at San Francisco.

B. FRANK GRAY, *Secretary*,
909 Hyde St., San Francisco, Calif.

FLORIDA STATE DENTAL SOCIETY

The next meeting of the Florida State Dental Society will be held in October, 1927, at St. Petersburg.

H. G. BOW, *Secretary*,
Deland, Fla.

THE DENTAL SOCIETY OF THE STATE OF NEW YORK

The Dental Society of the State of New York will hold its fifty-ninth annual session at the Hotel Statler, Niagara Square, Buffalo, Wednesday-Friday, May 18-20, 1927. A cordial invitation to attend is extended to all ethical dentists who are members of state societies. The Society bids all ethical Canadian dentists also a cordial welcome.

Monday-Wednesday, May 16-18, will be devoted to educational and surgical courses. For information and application blanks, address J. G. Roberts, 207 East Ferry Street, Buffalo, chairman of postgraduate courses, and C. E. Rose, Electric Bldg., Buffalo, N. Y., chairman of surgical courses.

Exhibitors wishing space, communicate with Guy M. Hughey, 40 North Street, Buffalo, N. Y., chairman of the Exhibits Committee.

All literary exercises, clinics, etc., will be held at the Hotel Statler.

A. P. BURKHART, *Secretary*,
57 East Genesee Street, Auburn, N. Y.

FIRST DISTRICT DENTAL SOCIETY STATE OF NEW YORK

The Better Dentistry Meeting of the First District Dental Society, New York, will be held Dec. 6-8, 1926, at the Hotel Pennsylvania, New York City.

As essayists, there appear the names of Rupert E. Hall, D.D.S., Chicago; Edward H. Hatton, M.D., Chicago; Russell L. Haden, M.D., Kansas City; U. G. Rickert, D.D.S., Ann Arbor; William Bebb, D.D.S., Chicago; Howard Channing Taylor, M.D., and George M. McKee, M.D., of New York.

There will be an oral hygiene luncheon. The N. Y. Tuberculosis and Health Association is participating with the First District Dental Society in the arrangements.

Topic discussions, which proved interesting and valuable last year, will again be an important feature. They will be conducted by men who are leaders in their respective fields.

Ample time will be set aside for clinics by members of the First District Dental Society and others outside the city.

The manufacturers' exhibits will be omitted and those attending the meeting will thus be able to concentrate on the scientific sessions, clinics, etc.

A fee of $5.00 is charged, giving admission to all scientific sessions and clinics.

JOHN OPPIE MCCALL, *Editor*,
100 W. 59th St., New York City.

OHIO STATE DENTAL HYGIENISTS ASSOCIATION

(A Correction)

The next meeting of the Ohio State Dental Hygienists will be held December 7-9 instead of December 1-3 as previously announced.

CORA V. DAVISSON, *Secretary*,
336 West 2nd St., Dayton, Ohio.

PENNSYLVANIA STATE DENTAL SOCIETY

The annual meeting of the Pennsylvania State Dental Society will be held in the Syria Mosque, Pittsburgh, May 10-13, 1927. Leslie Waddill, Jenkins, Arcade, Pittsburgh, is manager of exhibits.

A. C. BARCLAY, *Secretary*,
914 Highland Bldg., Pittsburgh, Pa.

CENTRAL PENNSYLVANIA DENTAL SOCIETY

The silver (25th) anniversary meeting of the Central Pennsylvania Dental Society will be held Feb. 15-17, 1927, at the Penn Alto Hotel, Altoona.

O. E. T. VON DER HEYDE,
314-316 Central Trust Bldg., Altoona, Pa.

BOARD OF DENTAL EXAMINERS OF THE DISTRICT OF COLUMBIA

The next examination of the Board of Dental Examiners of the District of Columbia for dentists and dental hygienists will be held the week beginning Jan. 10, 1927, at Georgetown University, Washington, D. C. It is desirable that all applications be in the hands of the secretary-treasurer at least ten days before the examination.

C. WILLARD CAMALIER, *Sec'y-Treas.*,
406 Medical Science Bldg.,
Washington, D. C.

OKLAHOMA STATE BOARD OF DENTAL EXAMINERS

The next meeting of the Oklahoma State Board of Dental Examiners will be held in Oklahoma City, Dec. 27, 1926.

CHARLES A. HESS, *Sec'y-Treas.*,
Idabel, Okla.

RHODE ISLAND BOARD OF REGISTRATION IN DENTISTRY

A meeting of the Rhode Island Board of Registration in Dentistry for the examination of candidates will be held at the State House, Providence, Tuesday-Thursday, Dec. 14-16, 1926, beginning each day at 9 a. m. Candidates shall present to the secretary of the board, at least one week before the examination, a written application on a form provided by the board, together with the examination fee of $20.00.

ALBERT L. MIDGLEY, *Secretary*,
1108 Union Trust Bldg., Providence, R. I.

COMPETITIVE EXAMINATION, DENTAL CORPS, U. S. N.

A competitive examination for appointment to the Dental Corps of the United States Navy will be held Jan. 24, 1927, at the U. S. Naval Medical School, Washington, D. C. Appointees must be citizens of the United States, between 21 and 22 years of age at the time of appointment, which may be one or two months later than the date of completion of the examination. Applications to take the examination should be made in accordance with a form which may be obtained from the Bureau of Medicine and Surgery, Navy Department, Washington, D. C., and must be accompanied by certificates of birth and citizenship, of graduation from an accepted high school or the equivalent and from a dental school, and two or more letters testifying to good habits and moral character. The examination will be both theoretical and clinical and the usual duration is from seven to ten days. No allowance can be made for the expense of persons appearing for examination.

E. R. STITT, *Surgeon General*,
U. S. Navy.

DENTAL PROTECTIVE ASSOCIATION

The annual meeting of the Dental Protective Association of the United States will be held at the Palmer House, State and Monroe Streets, Chicago, on the third Monday in December (20), promptly at 4 p. m. The report of the officers will be given; a board of directors will be elected and such other business be transacted as should come before the association. All members are urgently requested to be present. By order of the board of directors:

J. G. REID, *President*,
D. M. GALLIE,
Vice President and Treasurer,
E. W. ELLIOTT, *Secretary*,
39 S. State St., Chicago, Ill.

AMERICAN DENTAL ASSOCIATION

The Sixty-Ninth Annual Session of the American Dental Association will be held in Detroit, Mich., Oct. 24-28, 1927.

CHICAGO DENTAL SOCIETY MID-WINTER CLINIC

To dentists outside the city of Chicago who expect to attend the meeting of the Chicago Dental Society, Jan. 26-28, 1927 at the Drake Hotel, Chicago:

Please read this notice carefully and make a memorandum of it at once for yourself.

A one and one-half railroad fare has been secured for you provided 250 or more follow instructions. You can help in the following manner:

Be sure, when purchasing your ticket to Chicago to request and insist on your agent giving you a *certificate*. Do not make the mistake of asking for a receipt; that will not answer; and be sure to be at the station at least thirty minutes before train time so that your agent will have time to make out your certificate.

Certificates are not kept at all stations. If you inquire of your home station agent and find that he does not sell through tickets and certificates, he should be able to tell you the nearest station where you can secure your ticket and certificate. Purchase a local ticket to this station and from this station a ticket to Chicago (one way) and a certificate. No refund of fare will be granted if you fail to get a certificate.

Immediately on your arrival at the meeting, turn in your railroad certificate to the Transportation Committee at their booth in the lobby of the Drake Hotel for endorsement and validation. Do not fail to do this—it is your part and is contingent on you.

FRANK W. BOOTH, *Chairman*,
Transportation Committee,
Chicago Dental Society.

NEW YORK SOCIETY OF ORTHODONTISTS

The midwinter meeting of the New York Society of Orthodontists will be held at the Vanderbilt Hotel, 34th St. and Park Ave., New York City, Dec. 18, 1926. Both practical and scientific material of real value will be presented. Those who are interested in the growth and progress of this specialty cannot afford to miss this meeting.

CHARLES A. SPAHN, *Sec'y-Treas.*,
121 E. 60th St., New York City.

RESOLUTIONS ON THE DEATH OF DR. PLACE

WHEREAS, in the providence of an all-wise Creator, our fellow member, Dr. Benjamin F. Place, died, Aug. 8, 1926, and

WHEREAS, his ability, experience and skill as a practitioner, his keen interest in professional affairs and his friendly attitude toward his fellow members, especially the young, placed him in the front rank among the members of our society; therefore be it

Resolved, that we, the members of this society, deeply feel his loss and kindly presence, and hereby express our appreciation of his worth, and our sorrow over the close of a successful career; and be it further

Resolved, that a page in our minute book be set aside, and the secretary be instructed to inscribe thereon these resolutions, and that a copy be sent to his family, and to the professional journals for publication.

J. W. GODDARD
J. H. SLAUGHTER
S. B. LUCKIE

Adopted by the Dental Society of Chester and Delaware Counties, Sept. 29, 1926.

P. C. HOLLIS LAPP, *Secretary*.

BOOKS RECEIVED

The American Text-book of Operative Dentistry, In Contributions by Eminent Authorities. Edited by Marcus L. Ward, D.D.Sc., Professor of Metallurgy and Crown and Bridge Work, and Dean of the College of Dental Surgery, University of Michigan. Sixth Edition, thoroughly revised. 783 illustrations; 818 pp. Price, $10.00. Philadelphia and New York, Lea and Febiger.

There are ten contributors to this volume, embracing some of the leaders of dental thought in their respective fields. The attempt has evidently been made to condense the material so that an unwieldy volume should not result. The book has been carefully edited and well printed, and will prove interesting and instructive not only to the student but also to the practitioner.

LOOKING AT THE CHRISTMAS WINDOWS

By Ernest V. Madison

CHRISTMAS window time brings an annual revival of youthful enthusiasm.

The glass-faced wonderlands, piled high with holiday toys, fabrics or foodstuffs never fail to bring a thrill of delight.

They are interesting to child and to adult because they show seasonable merchandise and newly created articles.

For similar reasons, many progressive executives look through the advertising section of THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION.

Here they have an avenue of show windows where manufacturers, by picture and paragraph, display wares for the dental field.

These executives find interest on this avenue—every advertisement is brimful of it.

They look at the displays, leisurely—at their convenience.

You can look, too, by merely turning to the advertising section in this issue.

DENTAL CARIES

BUNTING reports, "In the study of dental caries and its prevention, we have been greatly impressed by the general prevalence of certain acid-forming micro-organisms in every lesion of dental caries. These organisms (Bacillus acidophilus) are found growing luxuriantly on the teeth and mucous membrane of mouths in which caries is prevalent, but are absent or are growing in an inconspicuous manner in mouths immune to caries. Masses taken from the surfaces of teeth which are undergoing beginning caries invariably contain high percentages of B. acidophilus organisms, and in many instances this organism is found growing in such areas in pure culture."

In view of this conclusive evidence that bacteria play a very important role in the production of dental caries, efforts to check their activities are based on a sound premise. Recent investigations verify previous data establishing the germicidal properties of Kolynos Dental Cream.

From eighty to ninety-two per cent of the oral bacteria are eliminated at each brushing of the teeth and this reduction persists for many hours. In addition, virulence tests have shown a lessened toxicity of the few surviving micro-organisms.

May we send a professional package?

THE KOLYNOS COMPANY

NEW HAVEN, CONN.

Kolynos cleans without grit.

Medical Science Again Recommends Soap As Best...

Strong endorsement of soap in a dentifrice may be drawn from the bulletin (Vol. VI, No. 12) of the American Society for the Control of Cancer.

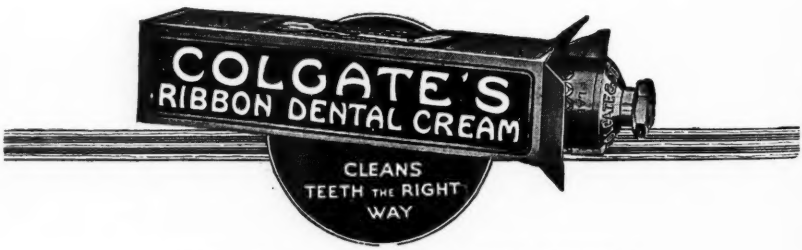
Here is what the bulletin says:

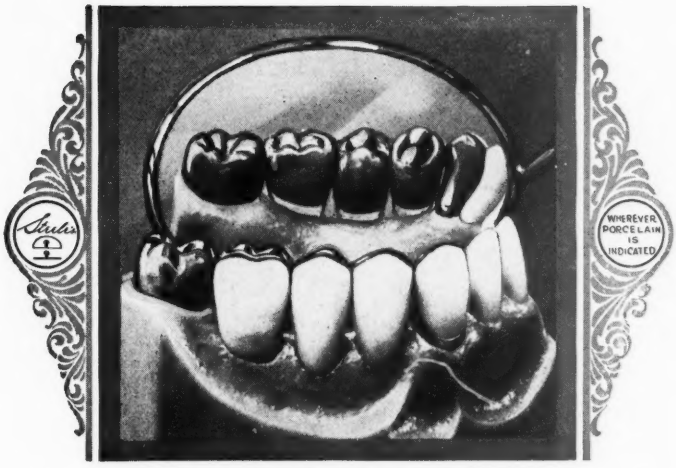
> "The most potent cause (of cancer of the mouth) is bad teeth."
>
> ". . . chemical disinfection of the teeth is an impossibility, and harm may result from the constant use of irritating chemical tooth pastes."
>
> "*Soap is the best aid to the tooth brush* in mechanically removing particles of food, masses of bacteria and mucus from the teeth and recesses of the mouth."

The effective ingredients of Colgate's Ribbon Dental Cream are a mild, vegetable-oil soap, and precipitated chalk, the two ingredients that modern authorities know are best. Colgate's contains no harmful drugs; no harsh chemicals.

In case you have not yet received the Bunzell Research Bulletins Nos. 1, 2, 3, and 4, we will be glad to mail copies on request.

Address Dental Dept. 939, Colgate & Co.
581 Fifth Avenue, New York.





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FOR :: EVERY :: CASE

EVERY one recoginizes the advantages of cemented facings. But there is a vast difference between cemented facings that are interchangeable and those that are merely replaceable. The utmost in precision, the basis of interchangeability is demonstrated in STEELE'S. All surfaces of the porcelain coming in contact with STEELE'S accurately made backings are ground to those precise standards necessary to accurate interchangeability. Since STEELE'S are cemented facings, which are accurately interchangeable (not merely replaceable) they can be used to advantage on every case. But interchangeability as exemplified by STEELE'S is lost when STEELE'S facings are used with substitutes for STEELE'S backings.

Steele's

INTERCHANGEABLE

TEETH

THE COLUMBUS DENTAL MFG CO · COLUMBUS OHIO

Prosthodontists

and

Orthodontists

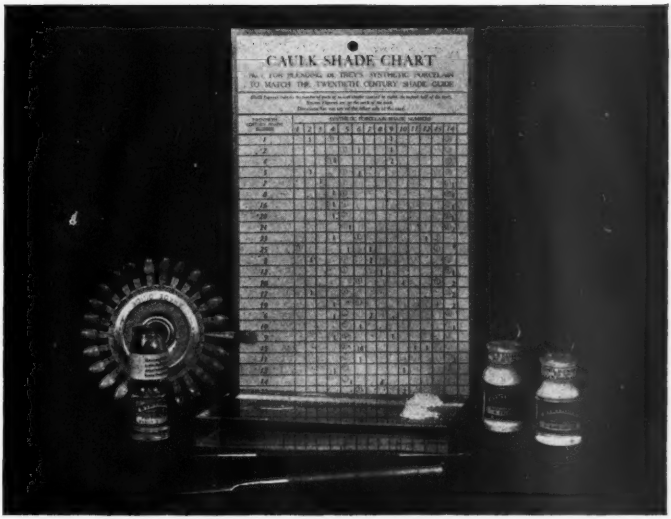
are using photography

With the increasing skill and understanding of prosthodontists and orthodontists, photography is coming to play an ever increasing part. The necessity of adapting the technic to the requirements of the individual case demands an accurate record of facial contours. From such photographs measurements are made of immediate supplementary value to data obtained from casts.

The Eastman Clinical Camera makes the taking of the photographs simple, easy, accurate and inexpensive. The pictures are 5 x 7 on either film or plates and of excellent quality because of the Kodak Anastigmat Lens with which the camera is fitted. Ask the Eastman Demonstrator to tell you more about photography as applied to dentistry.

Eastman Kodak Company

Medical Division Rochester, N. Y.



How to Find the Right Formula

Just say, "Send the Caulk Shade Charts to me, without charge."
Please mention the name of this publication in your request.

Narrow model Synthetic Cabinet Complete, $31.20

THERE is no mystery about perfectly matching any tooth or any part of it with Synthetic Porcelain.

You simply decide by comparison, for instance, that the incisal portion of shade 9 of the T. C. Shade Guide is exactly the shade you require.

Then consult the shade chart for blending. It shows that shade 9 is matched by blending one part powder No. 4 with one part No. 9.

In separate piles on the slab place these quantities of powder. Weighing or measuring is not necessary, simply estimate by bulk.

Off-color work by this method is not considered even a bare possibility by careful users of Synthetic Porcelain.

deTrey's Synthetic Porcelain
[CAULK]

Say: "I Saw it in THE JOURNAL"

Here is the poster which makes them remember four facts about teeth!

May we send it to you—free?

BUILD · STRONG · TEETH
BY GIVING THEM TOOTH-BUILDING FOODS
BY EXERCISING THEM WITH HARD FOODS
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BY GIVING THEM DENTAL CARE

THIS is an unusually attractive poster in color, designed by a famous artist. But it is more than attractive—it is *effective*, as well!

Modern research has emphasized the all-important part that diet plays in dentition. You strive to impress certain fundamental facts upon your patients. Note how forcefully the text of this poster suggests these facts. Hung in your waiting-room it will prove a valuable assistant to you, as it has to many other dentists.

We shall be very glad to send you as many copies as you require. You may also have miniature reproductions for distribution—little cards, printed in color, which make a great appeal to children.

Fill out the coupon below, indicating the number of posters and cards desired. With them we will include a complete set of other free publications, which have been prepared by the Educational Department as an important phase of the cooperation it offers to dentists.

EDUCATIONAL DEPARTMENT, POSTUM CEREAL COMPANY, INC.
Postum Building, New York, N. Y.

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J. A. D. A.—12-26

Please send me, free, the following publications:

.....Build Strong Teeth posters.

.....Build Strong Teeth cards.

Please send, also, a set of your other free publications.

Name.....

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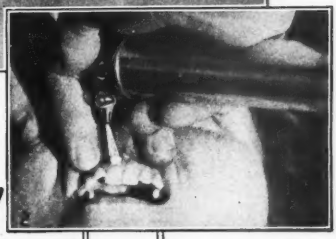
MEMBERS! Cooperate with your Advertisers



This wont hurt you a bit-See!

The nervous patient who betrays a fear of the hypodermic needle, can be almost instantly soothed by demonstrating the use of *ETHYL CHLORIDE GEBAUER.*

This is a particularly valuable feature in treating children, for by spraying the fluid lightly on the back of the patient's hand you can readily demonstrate that the tissues are numbed to pain.

When the patient has been reassured, it is easy then to benumb the point at which you plan to insert the hypodermic needle, as shown in Photograph No. 2, and proceed with your injection as shown in Photograph No. 3.

ETHYL CHLORIDE is very economical; ½c per patient is a liberal estimate of the cost of using it. This is due to the fact that the special leak-proof break-proof tube is designed so that it will deliver the fluid in a fine spray rather than a jet stream.

By adjusting the valve of the special GEBAUER tube, as shown in Photograph No. 1, you can regulate the spray to benumb an area the size of a pea, which is all that is necessary (Photograph No. 2). After the point of puncture is superficially anesthetized you can proceed to inject Novocain or other anesthetic at will (Photograph No. 3) without the patient even noting the touch of the needle, let alone the pain.

Ethyl Chloride Gebauer can be obtained from dental or surgical supply stores, or direct from us. 80 gram tube $1.75 each; 40 gram tube $1.10 each; Flexible Nozzle 75c; Graduated Dropper, 75c.

The Gebauer Chemical Co.
669 Erie Bldg., CLEVELAND, OHIO

Sixteen Famous Dental Preparations

Formulas of J. P. Buckley, Ph. G., D. D. S.

Only $8.50

This set is sufficient for several month's use in average practice; of certain formulas there is nearly a year's supply.

The young practitioner, with this set, has nearly every needed therapeutic agent, all of the finest quality.

Demonstration size packages are sold only in sets—never singly. To enable dentists to test Lilly Dental Preparations, formulas of Dr. Buckley, we offer the items listed below in demonstration size packages at the low price of $8.50.

ACID PHENOLSULPHONIC, Lilly. Caustic, astringent and antiseptic.

ANALGENTUM, Lilly. An analgesic ointment, stimulating and antiseptic.

DENTAL LINIMENT, Lilly. Local sedative for pericementitis and neuralgic affections.

DENTAL PASTE, Lilly. Two tubes.

DENTINOID, Lilly. A medicated artificial dentin for protecting the dental pulp and filling canals.

DEVITALIZING FIBRE, Lilly. For destruction of dental pulp.

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EUCALYPTOL COMPOUND, Lilly. Antiseptic.

EUCAPERCHA COMPOUND, Lilly. For filling root canals.

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LOCAL ANESTHETIC SOLUTION No. 2, Lilly. (Eight ampoules). For minor operations.

PROCAINE POINTS, Lilly. Powerful astringent, stimulant and bactericide.

REFRIGERANT COUNTERIRRITANT, Lilly. Counterirritant and sedative.

PHENOL COMPOUND, Lilly. Anodyne, antiseptic and disinfectant.

THYMOLIZED CALCIUM PHOSPHATE, Lilly. A pulp-capping and filling for small root canals.

A pamphlet by Dr. Buckley, giving information on preparations, is included in each set.

SUPPLIED THROUGH THE DENTAL TRADE

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INDIANAPOLIS, U. S. A.

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Forged Gold, One Piece, Complete Unit—

Reproductions of the finest Carvings of Natural Lingual Surfaces—

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Saves time, labor and painstaking effort—

No waste in Gold—

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Will soon be ready for distribution through established Dental Depots.

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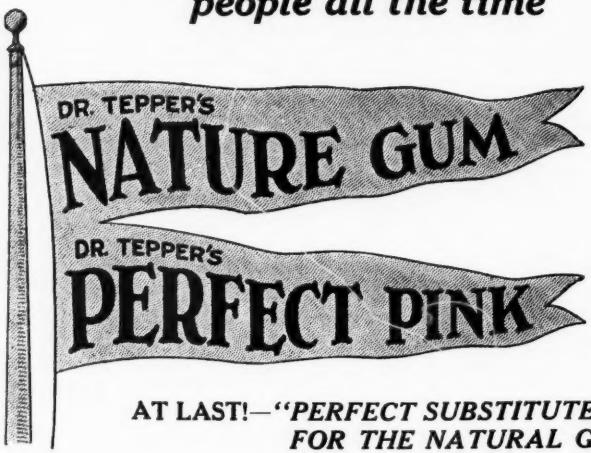
LINCOLN WAS WRONG

You can fool all the people all the time



AT LAST!—*"PERFECT SUBSTITUTES FOR THE NATURAL GUM"*

SO perfect they deceive the most penetrating eye—and will keep on "fooling all the people all the time"

NATURE GUM, $11.00 lb., ¼ lb. Boxes $2.75
PERFECT PINK, $5.00 lb., ¼ lb. Boxes $1.25
(*medium and light shades*)

WE manufacture a complete line of dental rubbers—and especially recommend for the base *Gold Plate*—*Dark Red* or *Maroon* veneered with "Nature Gum" or "Perfect Pink."

Send for complete price list and free samples

OUR GUARANTEE Every ounce of dental rubber produced by the Martin Rubber Co. is *unconditionally* GUARANTEED to give PERFECT SATISFACTION—or your money refunded.

Dr. Tepper's Nature Gum is not associated in any way with Dr. Tepper's Gum Lyke.

MARTIN RUBBER CO., Inc. **Long Island City, N. Y.**

WAITE
Worldwide Leadership
Dentists in all the foreign countries agree with their brothers in America that Waite's antiseptic base, Ortho and Para Mono-Iodo Phenol, is far superior to any ordinary salt or Ringer solution. They have learned that Waite's base is an anesthetic in itself that enhances the anesthetic powers of the Procaine or Cocaine and gives a quicker anesthesia—an antiseptic that prevents after-pains or soreness and heals tissue—a stabilizer that preserves the anesthetic so that it is pure when they use it.
Waite's is put up in bottles, convenient hermetically sealed ampules—and in "Carpule" form.
MADE BY
THE ANTIDOLOR MFG. CO.
100 Main St. Springville, N. Y.
Foreign Agents { The Dental Mfg. Co., Ltd., London
The Australian Drug Co., Ltd., Sydney
"Carpule" is a technical trade-mark identifying products manufactured by or under authority from Cook Laboratories, Inc., Chicago, U. S. A.
Waites
ANTISEPTIC
Local Anesthetic
Waites in ampules, bottles and
LOCAL ANESTHETIC
Now Waites
in "carpule" form

Why Dentists Approve It—

removes Film

83% of the dentists in a recent survey favored removing plaque from teeth by emulsifying it with a dentifrice made with a soap base and were opposed to removing film by abrasive action.

Because Waite's Anti-py-o Dental Cream removes the film by emulsification, with an antiseptic lather that penetrates the hard-to-get-at places other dentifrices don't reach, and contains 20% alcohol, which is the world's greatest solvent, it is the kind of dentifrice most dentists approve.

Large tube sent upon receipt of your professional stationery.

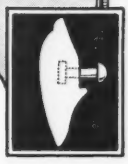
MADE BY
THE ANTIDOLOR MFG. CO.
100 Main Street Springville, N. Y.
The Dental Mfg. Co., Ltd.
London, Eng.
Australian Agents
The Australian Drug Co., Ltd., Sydney

FILM SHOULD BE REMOVED BY EMULSIFICATION JUST AS SOAP AND WATER REMOVES GREASE FROM A DINNER PLATE

Waite's
(ANTI-PY-O) DENTAL CREAM

NUFORM TEETH

TRADE MARK REGISTERED



A Pleasing Contradiction

In many ways we judge strength by bulk—it is an apparent contradiction to state that NUFORM ANTERIORS are thinner, yet stronger—but it is indeed a pleasing contradiction to be able to make.

It means the labors of our ceramists were crowned with success, comparable to that of metallurgical chemists who have evolved alloys of steel, for example, which, while lighter, are yet stronger.

Our ceramists knew how much this achievement was desired by the dental profession—the prosthetist and the laboratory man who used the bulky anterior because no one had yet evolved his long-wished for thin anterior—and for months they worked upon this problem, not content with the thought that even then NUFORM TEETH were

"as nearly perfect substitutes for natural teeth as it has yet been possible to make."

It is this persistency—this constant striving toward perfection which has created restorations recognized as the finest that a dentist can offer his patients.

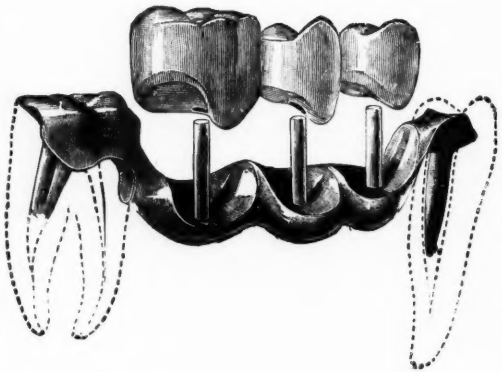
Write today for illustrated mold chart

UNIVERSAL DENTAL COMPANY

48th and Brown Streets

PHILADELPHIA, PA., U.S.A.

ASH'S TUBE TEETH



Ash's original Tube teeth, both Anteriors and Posteriors, have been used throughout the world for 90 years. They are renowned for strength, texture, adaptability and grinding properties.

They are easily repolished with pumice, water and rag wheel. The polished surfaces *stay clean in the mouth* owing to the density of the body.

They are supplied in moulds and sizes sufficiently comprehensive to cover all practical requirements.

PRICES:

TUBE ANTERIORS	Per Tooth	$0.50
In lots of 100	Per Tooth	.45
In lots of 500	Per Tooth	.42½
In lots of 1000 and over	Per Tooth	.40
BICUSPIDS AND MOLARS	Per Tooth	.45
In lots of 100	Per Tooth	.40
In lots of 500	Per Tooth	.37½
In lots of 1000 and over	Per Tooth	.35

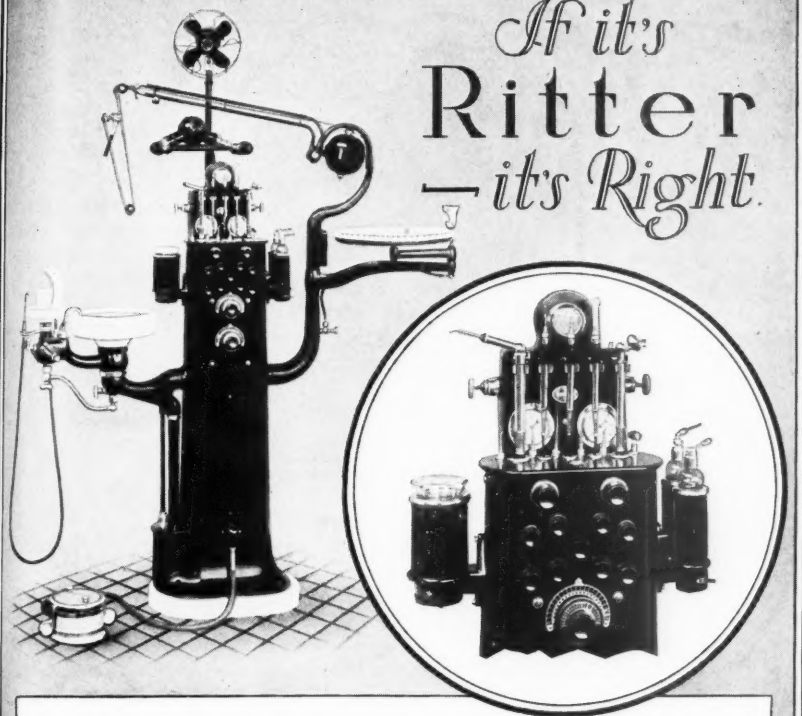
Prices subject to change without notice.

Ash's Tube Tooth Shade Guide comprising twelve shades covers all requirements. Price $2.00 or free with quantity lots of teeth.

Write for booklet covering all moulds on Ash Tube Teeth and if your dealer does not carry a stock, order direct from

CLAUDIUS ASH SONS & CO., U. S. A., Inc.

1 UNION SQUARE NEW YORK



If it's
Ritter
—it's Right.

Scientifically controlled electrical instruments at your fingertips

IN the Ritter Unit the plastic instruments alone are practically indispensable. A warm air syringe supplies either cold or warm air in the volume desired. An electrically heated cautery is placed under your positive control for removing hypertrophied tissue, for cauterizing pockets, for stopping hemorrhages, for lancing abscesses and for many other operations. Examination and antrum lamps produce a strong concentrated light properly focused and can be quickly and easily sterilized without injury. The air cutoff affords either high or low pressure spray as desired—non-dripping. And the many other appliances are all designed to help you save time in your daily operative work.

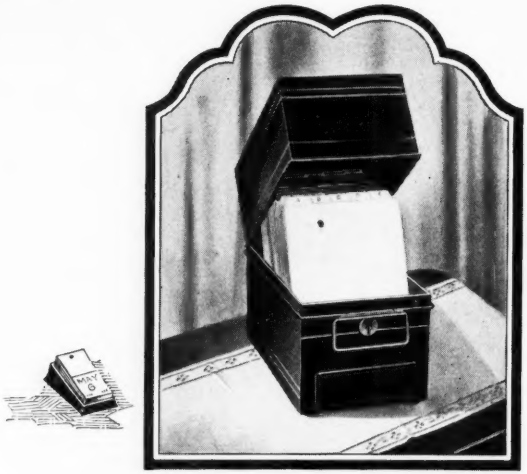
Then years of satisfying quiet service testify to the long lived staunchness and superior quality built into every Ritter Unit.

Send for descriptive literature showing the many advantages of this equipment.

Ritter

RITTER DENTAL MANUFACTURING COMPANY INC. ROCHESTER, N.Y.

Name_____ Address_____



Business Helps For Busy Dentists

Although dentistry is a profession it also has a business aspect that must be recognized; accurate records are just as essential as they are in any commercial enterprise.

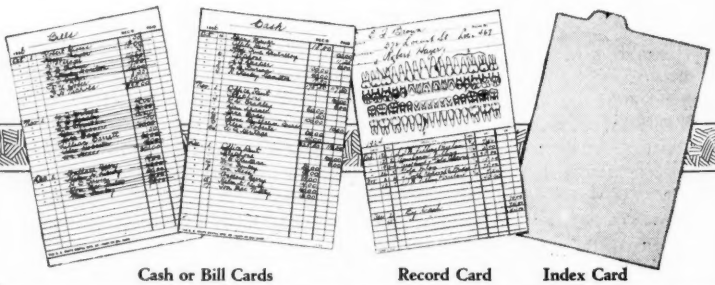
Time is so valuable to the dentist that nothing should be permitted to interfere with the productivity of his working hours. A system of accounting therefore must be simplified.

The accounting requisites shown on these pages have been in use by the profession for a number of years. They control the business side of dentistry and require minimum time to operate.

S. S. White Card Index System No. 2

1. **Unlimited Flexibility**
   Adapted for large or small practice.
   Can be started any time.
   Additional cards for new patients can be inserted in alphabetical order.

2. **Easy Reference**
   By arranging active accounts in buff guides, accounts not fully paid in salmon guides, and closed accounts, fully paid, in blue guides, reference is made easy.



Cash or Bill Cards **Record Card** **Index Card**

3. **No Dead Wood**
   Filing or destroying cards of patients who die or move away, keeps the records alive.
4. **Time and Labor Saving**
   Entry work, billing and reference to record cards consume little time.
5. **Bills and Cash Records**
   Specially ruled cards provide for independent record of bills sent out and cash received.

Price Complete $13.00

S. S. WHITE
EVERY DAY APPOINTMENT BOOK
No. 7

An appointment space for every half hour of every day in the year from 8:30 A. M. to 7 P. M. (Sundays included).

Open the book at any place and you have a full week of seven days, with sufficient space for special memoranda always available without turning a page.

There are fifty-four of these weeks in the book, twelve pages for monthly cash accounts, a page for cash summary and calendars for five years.

The book contains one hundred and twenty-six pages, printed on a fine paper; bound in rich red, durable cloth, 5¾ x 9 inches.

Perpetual in form, it can be started any time and used for a full year.

Price $1.50

EXAMINATION BLANK
No. 2

The diagram shows the symbols used to facilitate rapid bookkeeping. The reverse side is made up in the form of a memorandum account, whereon any desired entries can be made.

The diagram is printed in red ink

Size 5⅛ x 3¼ inches. Tablets of 50

Price $0.30

EXAMINATION BLANK
No. 3

The diagram is printed in red ink; the illustration of the teeth is a facsimile of that in the Warren Dental Ledger.

Size 4 x 4 inches. Tablets of 50

Price $0.30

For Sale by Dental Dealers
Literature on request

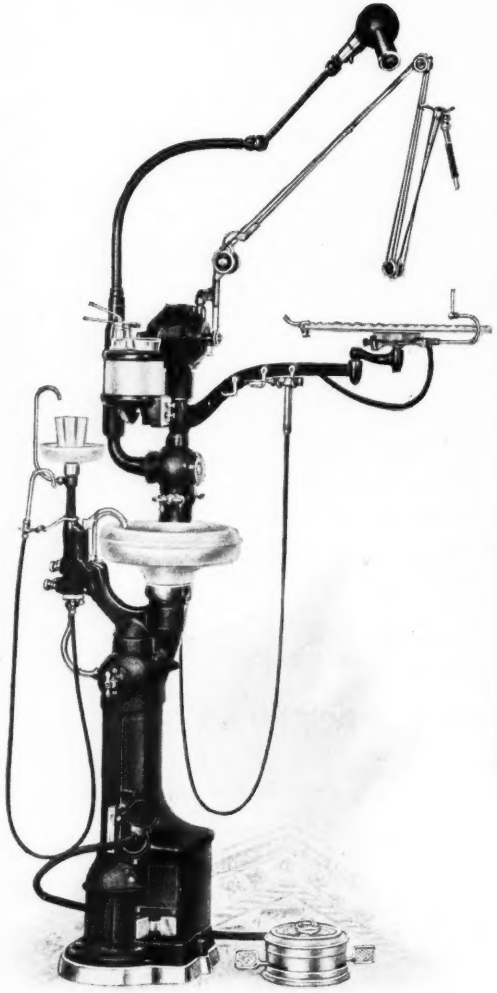
The S. S. White Dental Mfg. Co.
Philadelphia

Examination Blank No. 3

Every Day Appointment Book No. 7

Examination Blank No. 2

S. S. White Equipment Unit No. 3



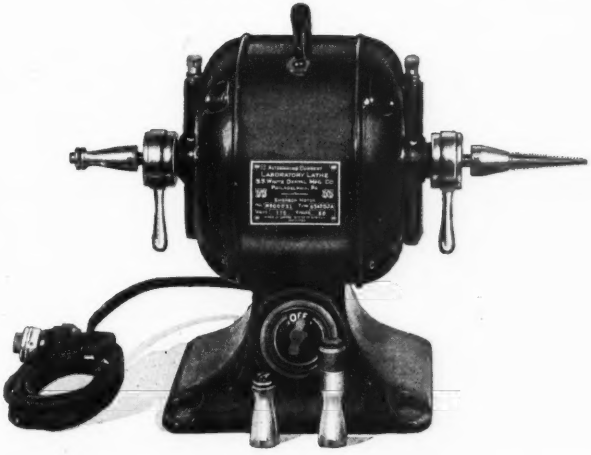
Its Features

Cuspidor
Saliva Ejector
Engine
Table
Light
Burner
Spray Heater
Cut-Off
Drinking Glass
Gas, Air and
Electric Outlets

Consult Your Dealer or write us for details

The S. S. White Dental Mfg. Co.
211 South 12th Street Philadelphia, Pa.

There's More Working Room Under the Spindles Of An S. S. White Laboratory Lathe



Dust proof housing - True running spindles - Two speed control
Simple, effective chuck release

The motor base is so designed that it does not extend under the motor shafts, and the spindles are high, 6½ inches, above the working bench.

Even with a pumice pan under the wheel, there is ample room to manipulate the piece in polishing.

With more than enough power for all laboratory operations the S. S. White Laboratory Lathe is the satisfactory motor lathe for all day and every day service in the busy laboratory.

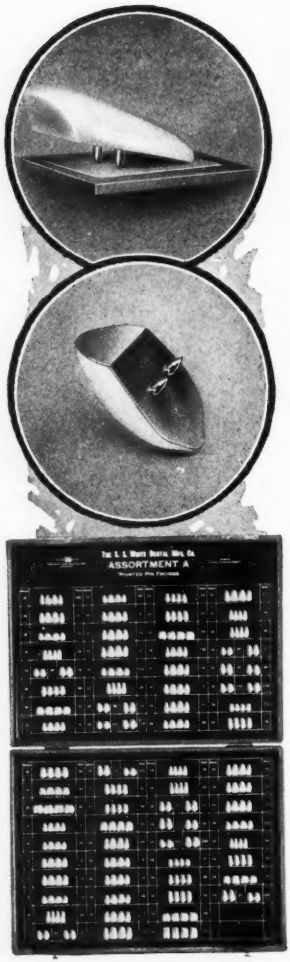
For either A. C. or D. C. current — Specify current when ordering

Price complete with cord and plug, two wheel chucks B, drill chuck E, and tapered chuck R $85.00
Less chucks 76.00

S. S. White Laboratory Lathe

At Your Dealer's

An Outstanding Feature of the S. S. White Pointed-Pin Facing



One point of special importance in the backing of a facing, is to get the holes in the backing-plate right as to diameter and position.

When you use S. S. White Pointed-Pin Facings, these two points are safeguarded. The pointed pins punch their own holes in the backing-plate; the holes must be right as to position. The shanks of the pins from the base of the point taper to the head are precisely the same diameter and perfectly formed. Consequently the holes they punch fit them,—there's small chance for flux or solder to find its way through the backing-plate to check or crack the porcelain.

Ample range of molds in all colors.

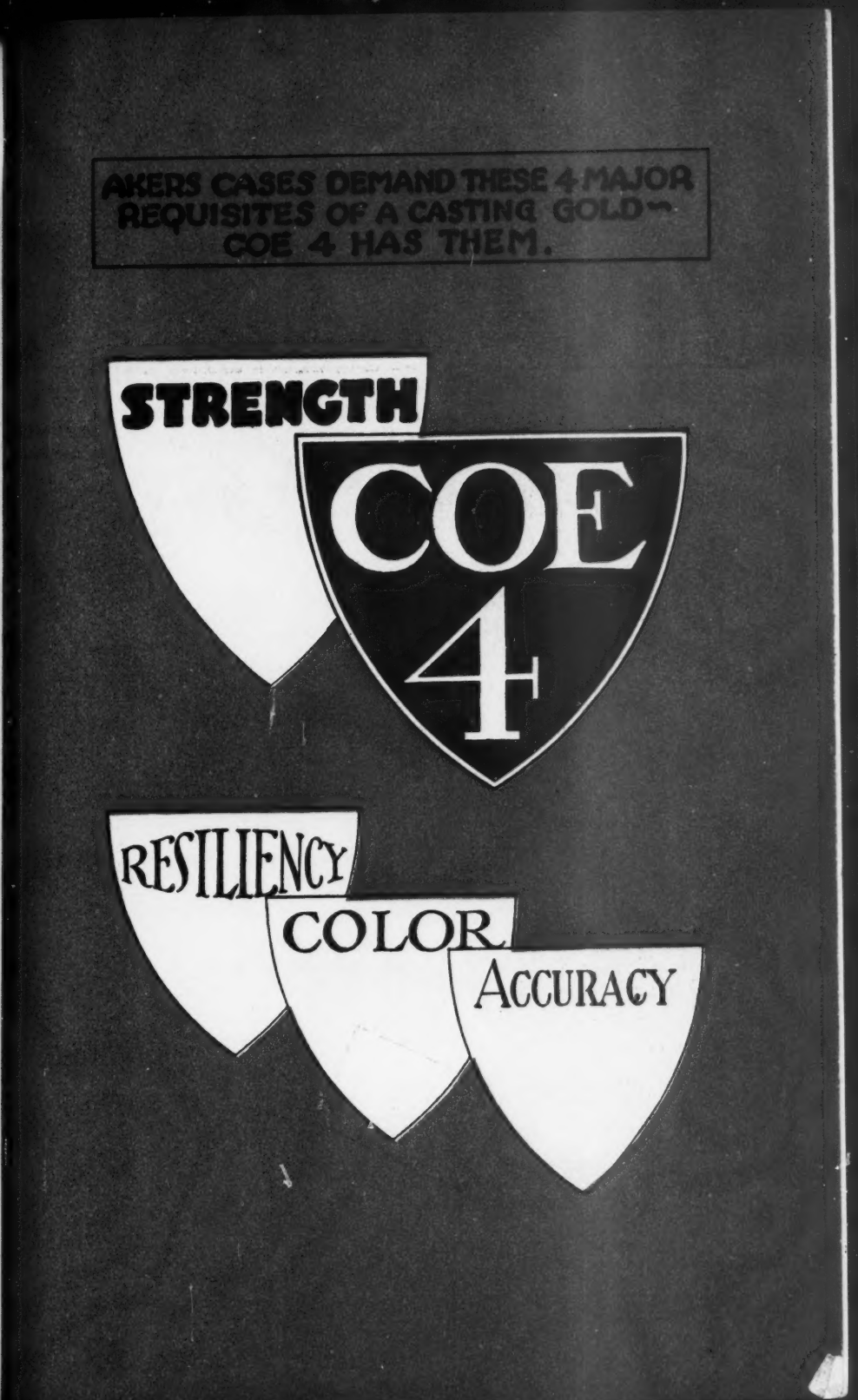
S. S. White Pointed-Pin Facings

Singly $0.40
In $100 lots ..... .36

Assortment "A," 280 Facings
$100.80

Subject to our Cash Discounts and to change without notice

The S. S. White Dental Mfg. Co.
"Since 1844 the Standard"
Philadelphia


AKERS CASES DEMAND THESE 4 MAJOR REQUISITES OF A CASTING GOLD— COE 4 HAS THEM.
STRENGTH
COE 4
RESILIENCY
COLOR
ACCURACY

Near your office is a laboratory whose technicians are certified Akers Technicians

COE LABORATORIES

COD LIVER OIL

THAT IS POTENT

Every batch of Mead's Cod Liver Oil from each trap full of fish is biologically tested and registered

What the Microscope reveals—Healed Rickets in the rat tibia after giving Mead's Cod Liver Oil.

THE TEETH AND VITAMINS

The accompanying photographs show teeth of persons of various ages who have lived for years on a diet of white patent flour, Oleo Margarine, Tea, Condensed Milk, Molasses, and the muscle flesh of fish. This is the diet of white people in the far-out posts of Labrador. It is deficient in Vitamins A and D. Night blindness (Xerophthalmia) and Rickets are extremely common with these people. The Eskimo who lives farther north at Nain has sound, perfect teeth. Rickets and Xerophthalmia are unknown to him because he eats seal blubber (Vitamin A) and Cod fish liver (Vitamin D) raw.

WHAT CAN THE DENTIST DO FOR RICKETS?

Rickets developes in the *growing* bony skeleton. The X-ray shows its appearance as early as the first month of life. Hess has observed that over 50 percent of babies born have Rickets at one time or other during the first two years of life. The dentist is more intimate with his patients than the physician—he sees the results of Rickets constantly. He can advise mothers to give their babies and children Cod Liver Oil daily. Professor Park says, "If infants were placed in the direct rays of the sun for a part of each day and were fed Cod Liver Oil for the first two years of life, more could be accomplished in regard to the eradication of caries of the teeth than all other ways put together, and Rickets would be abolished from the earth."

GIVE YOUR PATIENTS A SAMPLE

of MEAD'S STANDARDIZED COD LIVER OIL made in our own rendering stations in Newfoundland, and biologically assayed in our Laboratory.

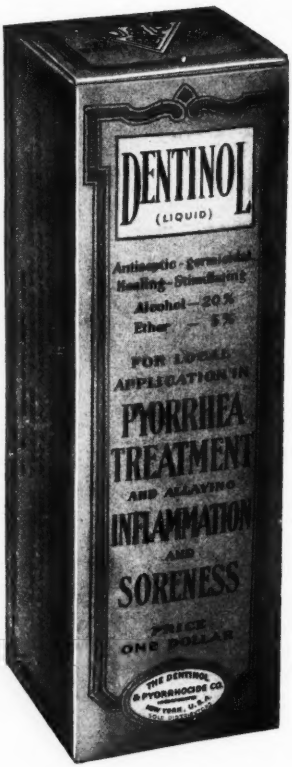
Samples Sent on Request

MEAD-JOHNSON & COMPANY

EVANSVILLE, INDIANA, U. S. A.

Makers of INFANT DIET MATERIALS

Whether the pyorrhetic condition is in the early, intermediate or advanced stage, you can depend upon



Dentinol

to do its work rapidly and satisfactorily in reducing soreness and inflammation, and in repairing diseased gum tissue.

DENTINOL is always applied FULL STRENGTH because, it is non-toxic and non-caustic. It destroys the germs lining a pyorrhea pocket, without destroying oral tissue.

DENTINOL contains Cresol, Oils of Birch, Camphor, Capsicum, Eucalyptus, Sassafras and Turpentine—Alcohol and Ether.

Use Dentinol - Compare Results

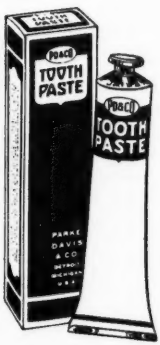
At all Dental Supply Houses

The Dentinol & Pyorrhocide Co., Inc.

Sole Distributors

1480 Broadway New York

Has Parke, Davis & Co. Achieved the "Happy Medium" in Dentifrices?



WE have prepared this product to conform strictly to what we believe a dentifrice should be—an efficient cleansing agent. A happy medium, in other words, between those preparations which fail to prevent the formation of tartar and those which are so harsh as to scratch and damage the enamel. (The base of P D & Co Tooth Paste has a hardness of approximately 2.75 to 3, according to Mohr's scale.)

Frankly, we believe it the kind of dentifrice that dentists will feel like recommending to their patients.

A few representative expressions of opinion from dentists:

"P D & Co Tooth Paste is just the product one would expect from Parke, Davis & Company."

* * *

"Think your tooth paste well balanced. Not too much abrasive in it to cause abrasion."

* * *

"Have recommended it and received very favorable comments from several patients."

* * *

"P D & Co Tooth Paste strikes the happy medium of all the preparations I have used. Am suggesting its use to my patients because I like it myself."

* * *

"Your paste apparently has all those deserving qualities a tooth paste should have."

* * *

"A tooth paste that is different from the average and highly efficient."

* * *

"I have been using the paste at the chair for cleaning patients' teeth, and like it very much for this purpose."

* * *

"I am using your tooth paste with gratifying results and I am recommending it to my patients."

* * *

"Found it to be a very nice and pleasant dentifrice."

* * *

"I am very much pleased with the paste and, being acquainted with the products of your Company, I will gladly recommend it."

PARKE, DAVIS & COMPANY
DETROIT, MICHIGAN

A Monument to Sound Theory

Diverted far from its original purpose, and now conspicuous as an advertisement of a French automobile, the Eiffel Tower is truly a monument to a sound theory.

Rearing its graceful structure aloft, until from its summit a widespread view of LaBelle France may be secured, each brace and stay and column and cross beam is joined to its fellow in a homogeneous unit by a varying number of Round Rivets.

French engineers, like those of every other land, subscribe to an inviolable engineering theorem—"a circle, for a given perimeter, contains a larger area than any other plane figure." Greater area of cross section means greater mass of metal—when the principle is applied to rivets—hence the universal acceptance of ROUND RIVETS to withstand shearing stress.

UNIVERSAL FACINGS are created to serve as monuments of sound prosthesis. As they, too, are subject to shearing stress, the only principle which could be accepted is the age-tried principle of Round Rivets.

When we speak of Universal Facings as monuments of sound prosthesis—we do not mean tombstones. The exquisite porcelain, with its natural shadings, sets them apart from the tombstone class of restorations.

UNIVERSAL ROUND-PIN FACINGS

"A Good Tooth Made Better"

Made by the manufacturers of **NUFORM TEETH**

and U. S. P. Teeth

Universal Dental Company

48th and Brown Sts. **Philadelphia, Pa.**

Get Results by Advertising in THE JOURNAL

Just One of their Good Features

MICROMETER-MEASURED accuracy is only one of the desirable characteristics of Clev-Dent Instruments. Not only must cutting instruments have less than two one-thousandths of an inch variation from the originator's design, but the cutting edge must be glass hard while the remainder of the blade is tempered to minimize breakage. Delicacy of design and beauty of finish are a part of the picture.

You can obtain Clev-Dent Instruments from your Dealer

THE CLEVELAND DENTAL MFG. CO.

CLEVELAND, CLEV-DENT OHIO, U. S. A.

Reading THE JOURNAL Advertisements is Both Interesting and Profitable

More Dentists Are Talking About These Fine Teeth Than Any Other Teeth In America!

FROM the very first, thousands of far-seeing dentists predicted that Justi Ekloform teeth carvings would be the outstanding revelation of the tooth industry. They were the unrivalled hit of the International Dental Congress—the topic of discussion of many study clubs and their success has grown to proportions never before attained by any tooth manufacturer in comparable time.

Dentists who know teeth unhesitantly call the Justi Ekloform teeth "Anatomical Masterpieces." They allow for natural movement of the mandible . . . selection of thirty-two shades in coloring . . . and made with Justi well known porcelain.

H. D. JUSTI & SON

Manufacturers of Porcelain Teeth Since 1864

FACTORY & SALES—32d & Spring Garden Streets

W. Philadelphia, Pa., U. S. A.

In These 9 Ways

Pepsodent Meets the Exact Requirements of Modern Practice in a Dentifrice

THE Pepsodent formula meets the opinion of leading dental authorities of the world. That is proved by records compiled from world-wide investigations conducted by the Pepsodent Research organization, one of the most thorough of its kind in this country or in Europe.

Modern opinion calls for 9 factors in a tooth paste. Pepsodent meets each one, fully and completely.

1—*Teeth Whiter:* For it removes the dingy film successfully.

2—*Polishing Agent:* Softer than enamel and remarkably efficient in giving high polish and luster.

3—*Salivary Flow:* Markedly increased by the mild acidity, hence better tooth protection.

4—*Mildly Acid:* Yet scores of tests show it harmless to enamel.

5—*High Polish:* Gives wonderful luster and polish, so plaques less readily adhere.

6—*Firms the Gums:* And in addition, gives them a fine tonal quality.

7—*Mucin Plaques:* Curdles and disintegrates them at all stages of their formation.

8—*Ptyalin Index:* Decidedly increased, to combat starch deposits better.

9—*Alkaline Index:* Decidedly increased, thus better combating causes of tooth decay.

We'll appreciate your sending the coupon. It will bring a tube of Pepsodent to try . . . . and information regarding it that you will find of unusual interest.

Pepsodent
REG. U.S. PAT. OFF.

The New-Day Quality Dentifrice
Endorsed by World's Dental Authorities

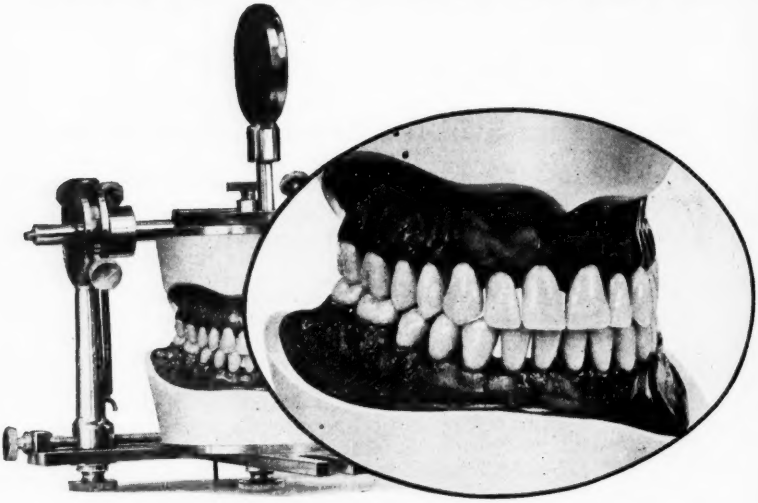
THE PEPSODENT COMPANY
6905 Ludington Building, Chicago, Illinois
Please send me, free of charge, one regular 50c size tube of Pepsodent, with literature and formula.

Name .....

Address .....
Enclose card or letterhead 2087

Say: "I Saw it in THE JOURNAL"

Following the Upward Trend of Prosthodontia



C. & G. SUPERIOR DENTURE

Scientifically built using the Wadsworth Universal articulator

—REPRODUCING—

Condylar and Mandibular Movements.

Combination of Con. and Man. Move.

Complete Mand. Movements.

Mechanical Reproduction of Masticatory Movements.

Correct tooth selection according to typal characteristics.

Contoured to facial requirements.

Vulcanized on stone models in Electrical controlled Vulcanizer producing uniform vulcanization without any distortion of rubber.

Finished in standard Red or Dark Elastic or Pure Para rubber with Granular Gums.

Uniform thickness of palate.

Natural festooned gums and palate.

Descriptive literature giving full details how to obtain correct mandibular registration and necessary procedure up to the mounting on articulator will be sent upon request.

Unsurpassed for Practical Service and Natural Appearance.

Trained craftsmen devote their entire time to these dentures.

The patient's needs are visualized as well as the Dentist's requirements.

The Denture that functions.

Ixolain or Mother Gum can be applied to anterior gum to produce the most natural effect.

Using S. S. WHITE natural teeth, Trubyte or Parks all crown, according to your prescription.

A Denture Worthy of the Most Exacting Requirements

DRS. CHRISTOPHER & GOLBECK, Inc.

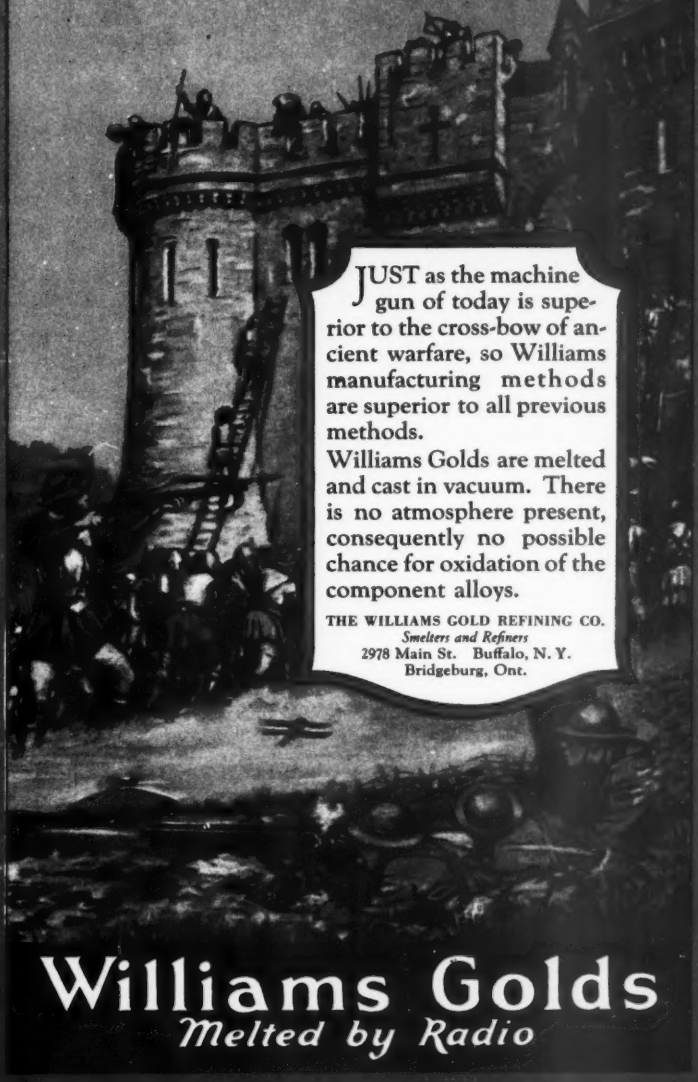
DENTAL LABORATORY SERVICE

339 South Wabash Avenue, Chicago

What Science has contributed to Warfare

Williams Research

has contributed to Dental Metallurgy



JUST as the machine gun of today is superior to the cross-bow of ancient warfare, so Williams manufacturing methods are superior to all previous methods.

Williams Golds are melted and cast in vacuum. There is no atmosphere present, consequently no possible chance for oxidation of the component alloys.

THE WILLIAMS GOLD REFINING CO.
Smelters and Refiners
2978 Main St. Buffalo, N. Y.
Bridgeburg, Ont.

Williams Golds

Melted by Radio

Get more for your Scrap Gold

Have it converted into Dental Golds or Specialties

GET more for your scrap gold by letting us convert it into Williams Casting Golds, Plates, Solders, Lingual Bars, Clasps or other Williams specialties.

The refining charge covers the entire cost.

If you would rather have the cash, the Williams policy of 100% returns, full value for all platinum, and a fair charge for our work, is your assurance for 100% satisfaction.

Most dealers will send your scrap gold to us if you ask them. If not, send it direct.

The Williams Gold Refining Company
Smelters and Refiners
2978 Main St. Buffalo, N. Y.
Bridgeburg, Ont.

Or, if you prefer, a check to help toward Christmas expenses

Williams Golds
Melted by Radio

Casting Gold Lingual Bars Filling Golds
Plates Shells Wire Solders Clasps Nuggets

See announcement on reverse side

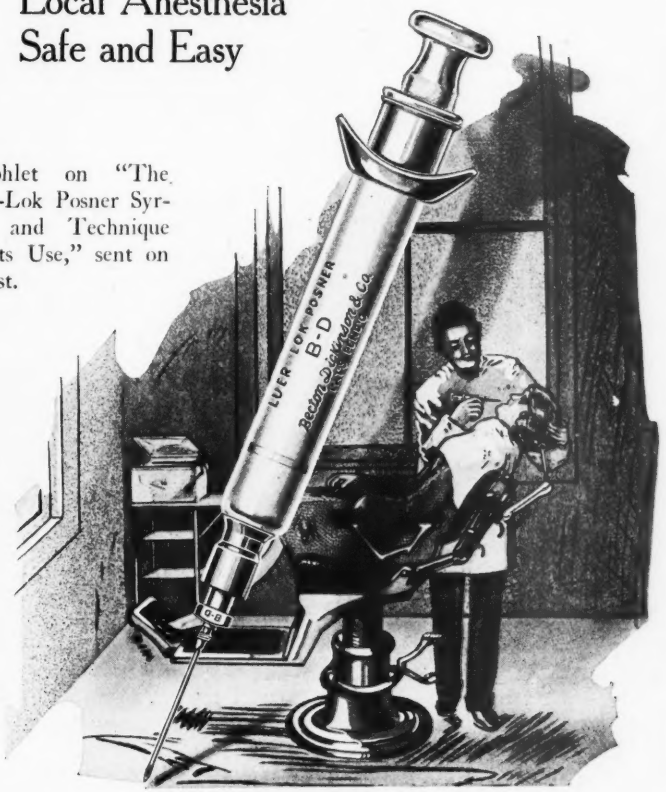
JDA DE

B-D PRODUCTS

Made for the Profession

The Luer-Lok Posner Syringe and B-D Platinum-Iridium Needles make Local Anesthesia Safe and Easy

Pamphlet on "The Luer-Lok Posner Syringe and Technique for its Use," sent on request.



Sold Through Dealers

BECTON, DICKINSON & CO.

RUTHERFORD, N. J.

Makers of Luer Syringes, Asepto Syringes, B-D Water Syringes, Dental Needles, Chip Blowers, Sphygmomanometers and B-D Thermometers.

Efficiency Plus

American Cabinet No. 120 combines mechanical perfection and attractive appearance in a greater degree than any other cabinet made. Make us prove this. Ask for circular A-D 33.

The American Cabinet Co.

Two Rivers, Wis. Rahway, N. J.

WHAT is *Wrong* With *This* Picture?

(Answer at bottom of page)

The artist has endeavored to picture a cement that would fill every requirement of the dentist.

He has shown all the qualities that the best oxyphosphate cement could possibly possess but they do not complete the picture.

Something is missing and here it is—

SMITH'S COPPER CEMENT

Place this in the center and—

GERMICIDAL ACTION

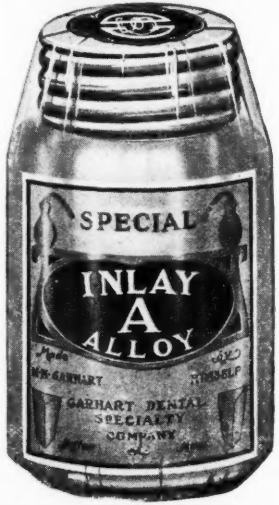
This will complete the picture.

LEE S. SMITH & SON MFG. CO., PITTSBURGH, PA.

A TRINITY OF EXCELLENCE

60% Silver Shavings

67% Silver Filings

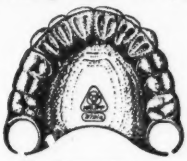


67% Silver Filings or Shavings

GARHART DENTAL SPECIALTY CO.
Somerville 42, Boston, Mass.

Baseplates
for dental prosthesis of Wipla Metal (V2A)

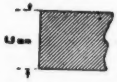
Patented in Germany and in foreign countries.



1/1 of natural size

Comparison by Diagrams of Thicknesses and Weights of Baseplates made of

Scale 5:1



Rubber

Tensile strength
5·2 kg p. sq. mm

Gold

Tensile strength
43 kg p. sq. mm
Weight 21·5 g

Wipla Metal

Tensile strength
80 kg p. sq. mm
Weight 8·3 g

Disadvantages inherent to old systems:

Rubber shows small tensile strength — 5·2 kg p. sq. mm — therefore is liable to crack and to break after short use.

With substitutes for gold decompositions are inevitable bringing on change of colour and dissolution of the plate. (The decomposed metal is injurious to health.)

Gold being very expensive the number of consumers is only very small.

Advantages offered by Wipla Metal:

The Wipla Metal Baseplate shows greatest tensile strength wherefore clean fractures and deformations are impossible.

Wipla Metal never becomes corroded by the fluids in the mouth — therefore no changing of colour and decomposition, no disagreeable taste of metal, no damage to health.

The price — as compared with gold or rubber — is very favourable; everybody therefore can easily afford to use WIPLA MET L BASEPLATES.

WIPLA METAL BASEPLATES FOR PROSTHETIC PURPOSES

are therefore most agreeable and most durable and are also favourable to health.

KRUPP

Fried. Krupp Aktiengesellschaft, Essen
Dept. „WIPLA", Bahnhofstrasse 94 340egl

Palladium and platinum in precipitate form.

We Will Recover Your Platinum and Palladium

DON'T you think that now, just before the Holidays and the New Year, is an excellent time to clean out your scrap drawer and send in the contents for refining?

Simply wrap up your scrap gold and send it to us. Or you can ship it through your dealer if you prefer.

Platinum and palladium invariably occur in dental filings, bridges, ingots and wire. The amounts can only be determined by careful assaying and refining.

We Give Full Allowance

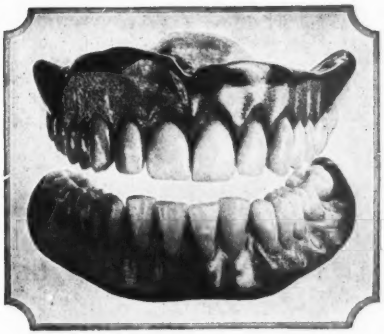
When you send your scrap gold to us for refining you receive full settlement for the platinum and palladium contents as well as the gold and silver. Returns may be had in new precious metals or cash. Through your dealer if you wish.

We still have a few copies of E. T. Tinker's treatise on "Fixed Bridgework." Just send your name and address and we will send you a copy free.

We wish you a Merry Christmas and a Happy New Year.

SPYCO SMELTING & REFINING CO.
51 SOUTH THIRD STREET
MINNEAPOLIS MINNESOTA

Expressing Personality



"ART-CRAFT" DENTURES

embodying Esthetics and Masticating Efficiency, express Personality, and are Healthful to your Patient.

"Oral Art" Service Upon Request.

The Scientific Technic of these "Art-Craft" Dentures are an example of "Oral Art" expressed in Better Dentistry, and a Ready Appreciation is insured on the part of those who are to wear them.

HENRY P. BOOS

DENTAL LABORATORY

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Perfection Impression Compound

Kerr Perfection Impression Compound facilitates accurate, natural, comfortable and efficient restorations, and is indispensable to the Prosthetist in imitating Nature.

Made in Regular Cakes, Tracing Sticks and Wafers for Your Convenience

Kerr Perfection Impression Compound Cakes

Test Impression taken in Kerr Perfection Impression Compound Showing Complete Muscle Trimming

Kerr Perfection Impression Compound has the essential qualities that make it possible to obtain the desired results in impression taking, no matter how difficult the case may be.

By the Greene System of Impression Taking you will eliminate all the guess-work and know by actual tests In Advance what the resultant outcome will be. Booklet giving this information sent on request. It's free!

Sold at all Reliable Dental Depots

KERR
REG. U. S. PAT. OFF.

Snow White Plaster

Kerr Snow White Plaster is made from carefully selected material, which is ground extremely fine and specially processed to give a plaster that is dense, hard, breaks clean, and imparts every detail and an exceptionally smooth surface.

No. 1 Plaster

Natural Setting about 18 minutes

An all-round Plaster for models, vulcanizing, impressions, and general purposes.

No. 2 Impression Plaster

Rapid Setting 5 minutes

An impression Plaster scientifically prepared to set accurately in five minutes.

Quality standardized, tested, and dependable and every can the same to the last portion. Put up in 10-pound tin cans and 100 and 250-pound steel drums, which are securely sealed against dirt, dampness, etc.

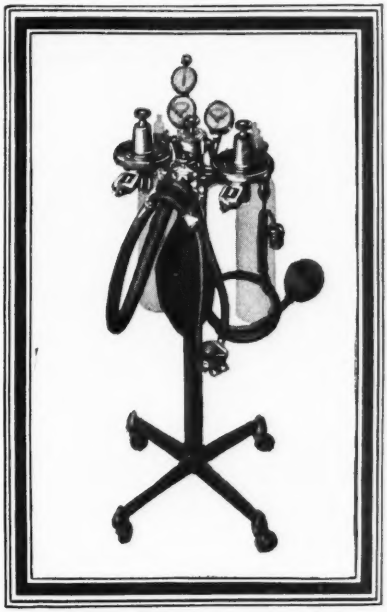
Sold at all Reliable Dental Depots

DETROIT DENTAL MFG. CO.

6081-6095 Twelfth St. DETROIT, MICH., U. S. A.

because it is accurate

AND HAS EVERY PRACTICAL DEVICE FOR THE ELIMINATION OF ERROR, THE "HEIDBRINK" MODEL T IS USED BY EXPERTS, AND CHOSEN BY BEGINNERS FOR QUICK MASTERY OF ANESTHESIA.



Note the "right-at-hand" control—on top within easy reach . . . the accurate sight-feed indication of dosage always in full view . . . the Selective Emergency Valve that gives absolute *emergency* control by means of a single instantaneous manipulation. Every mechanical device is for Safety . . . for Efficiency . . . for Successful Anesthesia.

These are but a few of the exclusive features. Write for our Free Catalog 6 which tells about the others.

The HEIDBRINK COMPANY

Minneapolis Minnesota U.S.A.

Many look upon electricity as a substitute for gas for heating Vulcanizers.

May we send you a description of this modern Vulcanizer?

The more progressive men choose the

Lewis Automatic Electric Vulcanizer

because of their desire to own the best.

BUFFALO DENTAL MANUFACTURING COMPANY
Kehr and Urban Streets
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Dioxogen

The pain and soreness following extraction, and the discomfort incident to plate adjustments are very greatly relieved by DIOXOGEN, and what is more important—injured tissues are protected against infection.

DIOXOGEN acts almost as an anesthetic in the mouth: the relief from pain and the soothing effect on the tissues are so pronounced that the intervals between office visits can be materially shortened.

In Pyorrhea cases the destructive action of DIOXOGEN on pus is of signal assistance; it clears the field and at the same time removes one of the chief sources of reinfection.

Absolutely harmless, DIOXOGEN is safe to entrust to patients.

A sample will gladly be sent to professional men on request.

THE OAKLAND CHEMICAL CO.
59 Fourth Avenue New York, N. Y.

Clean and Polish with REVELATION

then examine the tooth-surface with a magnifying mirror

Send your card for a full-size can of REVELATION without charge, for testing purposes

THERE is no grit in REVELATION TOOTH POWDER. Nor is it druggy. Yet, without grit and without acids or alkalis—REVELATION *polishes* so well that many dentists use it for prophylaxis instead of pumice preparations.

Clean and polish with REVELATION—we will send you a can if you ask for it—and after cleaning and polishing with it, examine the tooth surface with a magnifying mirror.

See the lustre. Ask yourself if tin-oxyd would have done better.

Well over two million cans of REVELATION go out yearly. People start using it because their dentists advise it; little else is done to create demand. And people don't very often switch from REVELATION. Dentists, who familiarize themselves with it, don't switch very often either.

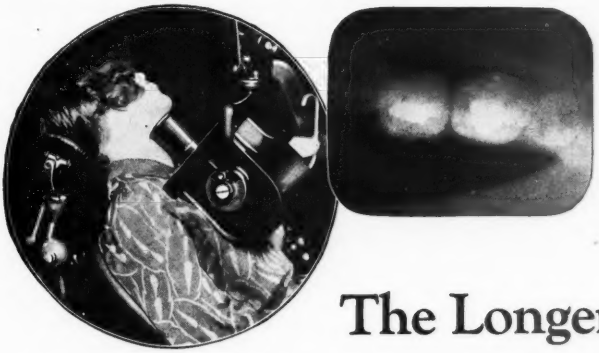
REVELATION is not only a cleanser, disintegrating deposits and polishing in a really remarkable way—it also helps to keep gums firm and aids in relieving tenderness around necks of the teeth.

REVELATION *for* Teeth *and* Gums

Never in paste form

because we don't believe glycerine is good for gums.

AUGUST E. DRUCKER COMPANY
2679 California Street
San Francisco, Calif.



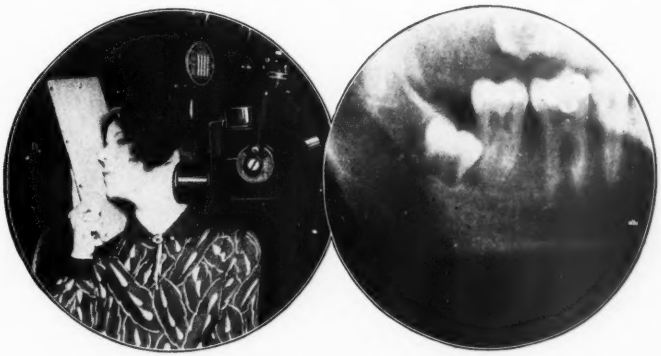
The Longer a Dentist Uses a CDX

the more appreciative he becomes of its remarkable flexibility, safety and range.

The illustrations show the operative positions and resulting radiographs (unretouched) of the orientation of an unerupted lower third molar in an adult.

Particular attention is called to the easy relaxed position of the patient as well as the close proximity of the apparatus to the patient—which is not only practical but 100% electrically safe—when a CDX is used.

VICTOR X-RAY CORPORATION
Dental Department
2012 Jackson Boulevard Chicago



The Prophylaxis of Dental Caries

The Cause of Dental Decay: The presence in the mouth of lactic and butyric acids formed by bacterial action on food particles.

The Results of Dental Decay: Roughening, softening and penetration of the enamel; damage to the dentine; the formation of cavities affording lodgment for pathogenic organisms with subsequent development of root abscesses, gingivitis, pyorrhea, etc.

How to Prevent Dental Decay: The daily, systematic application of a suitable, non-irritating, non-abrasive alkaline fluid is the best and most practical method of controlling or preventing dental decay. This is not an empty assertion, but it has the support of authority.

Note. Thousands of your fellow-practitioners have made the discovery that "Phillips' Milk of Magnesia" is just such a fluid. It completely fills the bill. It is the ideal alkalinizer for use in the human mouth.

WHY YOU SHOULD SPECIFY "PHILLIPS' MILK OF MAGNESIA"

a. It is pure, i. e., free from every trace of deleterious substances.

b. It is a hydrate and, therefore, has a special affinity for acids.

c. It acts immediately and efficiently, and has no disagreeable effects.

d. It is three times as efficient as bicarbonate of sodium and *fifty times* as powerful as lime water in neutralizing acids.

HOW TO USE "PHILLIPS' MILK OF MAGNESIA"

Kindly instruct your patients to rinse the mouth with a tablespoonful of "Phillips' Milk of Magnesia," at least twice a day, and invariably at bed-time, as acidity is most likely to develop during sleep.

The nightly application should be made in the following way: Cleanse the teeth well with a toothbrush and warm water. Rinse the mouth thoroughly, then take a tablespoonful of "Phillips' Milk of Magnesia" and work it back and forth through the spaces between the teeth for a few moments—the object being to reach every surface of all the teeth. After rejecting the superfluous portion *do not rinse the mouth again, but allow the alkaline film of Magnesia to remain on the dental surfaces.*

An excellent plan is to use "Phillips' Milk of Magnesia" as a dentifrice, on the toothbrush, instead of preparations containing precipitated chalk.

PHILLIPS' Milk of Magnesia

CAUTION. The dentist is advised to beware of imitations of "Phillips' Milk of Magnesia." Kindly prescribe in original 4-ounce and 12-ounce bottles obtainable from druggists everywhere.

"Milk of Magnesia" has been the U. S. Registered Trade Mark of The Charles H. Phillips Chemical Co. and its predecessor Charles H. Phillips since 1875.

Prepared only by **The Charles H. Phillips Chemical Co., New York and London**

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Porcelain Work

It is the earnest purpose and endeavor of the Lochhead Laboratories, Inc., to give to the Dental Profession and their patients the greatest satisfaction possible in Ceramic Dentistry.

PORCELAIN INLAYS, made by employees of long experience.

GOLD INLAYS, carved and cast with the greatest care and delicate carving.

PORCELAIN JACKET CROWNS, special attention given to every case by the same experts who have caused an ever increasing demand for their crowns.

Cooperation by the Dentists to the extent of giving us good impressions of correctly prepared teeth will insure the most pleasing results.

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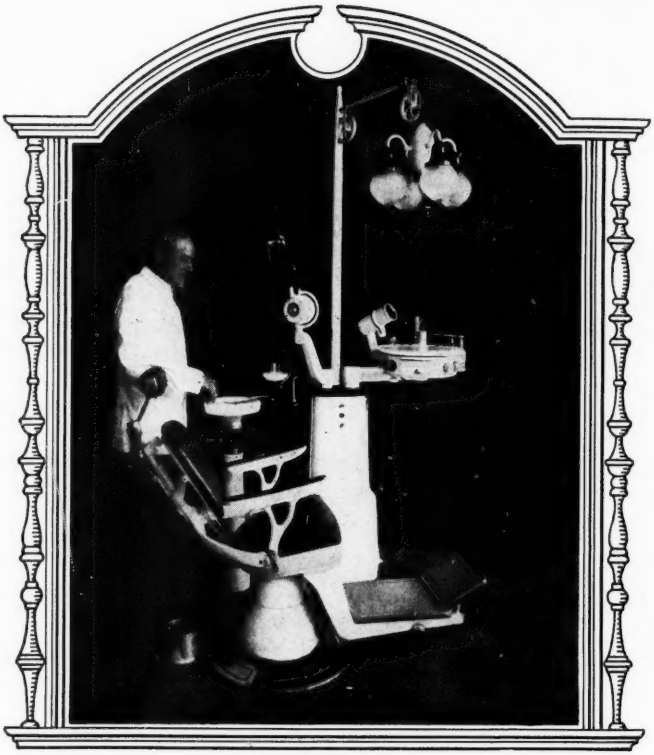

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I wonder how much sooner I'd have been successful... how much more enjoyment I'd have gotten from my work if I'd had this years ago. I wonder...

The Electro Dental Unit is the only unit that really grows; the only unit with an electric bracket table; the only unit where reaching across the patient is eliminated; the only unit where the "instruments that terrify are hidden from the patient's eye" and kept free from dust and contamination.

Write for Catalog and Prices

Electro Dental Manufacturing Co.
Philadelphia

ED MFG. CO.

VBS

To lay a Log of Wood upon the Fire
To dress the Fir Tree in its Gift attire
To sing Old Carols of the Savior's Birth
To fill all Hearts with Happiness and Mirth
To Symbolize the Day with meanings True
To wish your Neighbor what we wish for you

A Good Old-Fashioned Merry Christmas

The
Medical Protective Company
of
Fort Wayne, Indiana

Preach the gospel of Gum Massage

MODERN dentistry emphasizes more and more the importance of gum massage as a treatment for diseases of the oral tissues — gingivitis and pyorrhea. The beneficial results derived from this practice are pointed out in no uncertain terms by many of the ablest investigators.

Gum massage is an important factor of preventive dentistry

As one specialist states:

"The instant the gums are brushed properly, the blood starts to flow more rapidly and a new life and color make their appearance. After a thorough prophylactic treatment and a lesson in mouth-brushing it is not unusual to see the tissues lighten in color, possibly two or three shades in twenty-four hours."

It is realized that massage of the oral tissues is the most effective method of overcoming the harm done by the coddling effect of our modern soft diet, which deprives the gingival tissues of the healthful frictionizing that a diet of rough, coarse food would yield to them.

Proper use of the tooth brush includes brushing of the gums. Teaching a proper method whereby this is accomplished is an accepted routine in many dental offices. The technique is not difficult for the patient to learn, and such instruction is indeed a splendid service for the dentist to render.

* * *

THE ziratol content of Ipana Tooth Paste makes it particularly useful as a supplement to massage in toning and restoring softened gum tissue. Many dentists regularly use Ipana in their work at the chair and in teaching their patients the correct technique of gum massage.

MEMO to: Bristol-Myers Co., 75A West St., N.Y. City

Without charge or obligation kindly send a professional package of IPANA TOOTH PASTE.

*Name*_____ D.D.S.

*Address*_____

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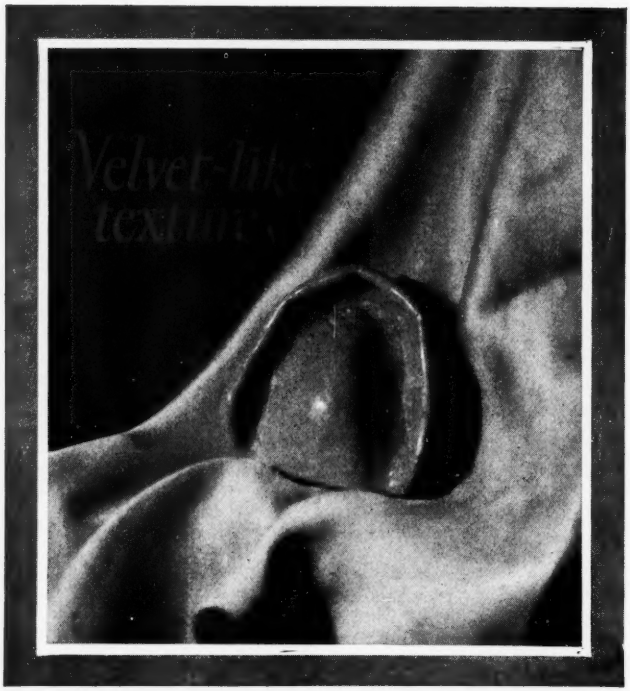
CO-RE-GA
The Perfect Powder for Dentures
The years have woven a close companionship between this Company and its many friends in the profession.
May your Christmas be one of Joy and the New Year full of Health, Happiness and Prosperity.
COREGA CHEMICAL CO.
CLEVELAND, OHIO
AND MONTREAL, CAN.



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IMPRESSION MATERIAL

The velvet-like texture of Dresch Impression Material, together with its superior flowing quality and softness at low temperature and rapid hardening at open-mouth temperature, tensile strength and workability, assure faithful reproduction of every delicate curve, line and contour. Try a pound of Dresch. Put it to the test. Buy a trial pound from your dealer--$1.20.

THE RANSOM & RANDOLPH COMPANY
Toledo, Ohio

For Gingivitis
try this

AFTER prophylaxis advise the use of SQUIBB'S DENTAL CREAM, *made with more than 50% of Squibb's Milk of Magnesia*, and watch the gums take on the color and firmness of perfect health and vitality.

SQUIBB'S DENTAL CREAM contains no astringents, or other irritating substances. It maintains the health of the gums through the elimination of the environmental conditions which are responsible for gingivitis.

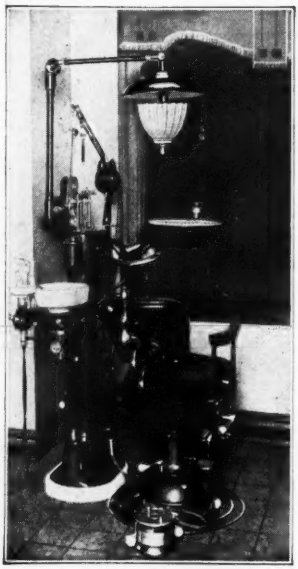
Let us carry your dentifrice responsibility.

Send your card for a complimentary package

E·R·SQUIBB & SONS

Dental Department

80 BEEKMAN STREET · NEW YORK



BOSWORTH UNIT LIGHTS

Here is a new Unit Light that gives light. It can be adapted to all makes of unit equipment, or where a cuspidor only is attached to a chair.

This light adapted to the unit brings it near the field of operation, can be reached quickly for change of position, and can be used for reading X-Ray films without turning away from the chair.

Adapt this light to your unit and you will eliminate eye strain, thereby increasing your efficiency.

The light illustrated is our Type Five Unit Light which we consider the most efficient light, but we can furnish on special order a four cluster fixture with holophane shades.

Order of your dealer today, or a request for further information will be gladly answered.

SOLVITE MATERIALS

are recommended for use with Akers Technique but are better than the rest for partial impressions and all classes of castings.

SOLVITE IMPRESSION MATERIAL is a soluble preparation of extreme fineness which separates itself easily from the model and will break clean.

SOLVITE SEPARATING FLUID is better and different than others—will peel off when dampened all in one piece.

LOHEET NO. 1 is the finest investment material made. It produces a very hard smooth model to cast directly to. Also used to paint on wax patterns.

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IMPRESSION TRAYS. A set of nine trays for taking better impressions for all partial impressions.

Send for illustrated circular.

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In Local Anesthesia

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BRAND OF BUTAMIN

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Rapid, complete and safe anesthesia.
Suitable both for injection and surface application. Economical.

SUPPLIED in tablets with and without epinephrin. Each sufficient for 3 c. c. of 1% solution, the strength for conduction and infiltration.

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Crescent Assortment of 1,500 Gutta Percha Nerve Canal Points

The Most Complete Assortment Ever Offered

Made from pure gutta percha, very tough and extra stiff. They will permit the operator to insert them to the end of the most tortuous canal and form a perfect seal.

The long lengths are especially desirable and useful for such methods of root-canal filling as Dr. Callahan's and others where the point is dissolved in the canal. Although made extra stiff, they dissolve readily.

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Send me one box Crescent assortment of 1500 Gutta Percha canal points, postpaid: Within ten days of receipt, I agree to remit $2.25 for same, or you may charge through my dealer, if I decide to keep them, otherwise I will return the unused portion to you.

Dr. .....

Address .....

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With Problems that have been Solved

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You know beforehand your work will come out right if you use the right material.

No better, nor more desirable alloy is presented to the Dental Profession than this.

CASTING GOLD

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Metallurgists
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MAKERS OF McCOY OPEN TUBE ATTACHMENTS

TABLE CLINIC

You are cordially invited to attend a table clinic on

The Thimble Bridge
and
Porcelain Jacket Crown

To be held in the Avenue of Palms in the Drake Hotel each day of the meeting of the Chicago Dental Society, January 26-27 and 28, 1927.

REMEMBER! IN THE AVENUE OF PALMS

If you can not attend send for booklet, "The Better Bridge."

M. W. SCHNEIDER—DENTAL CERAMIC LABORATORY
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Whether it's Smocks or Dresses—
Forty-eight years' Pride of Manufacture goes behind every Label that we sew into a garment.

Every ANGELICA garment is made with the same scrupulous care and attention that the particular Dentist demands in all supplies.

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Style 41TH.8

1 for $2.00
3 for $5.70
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Universal Analgesic Sedative

What It Does

For the Patient — Before and after operation, allays pain and nervousness, and when given at night, induces restful sleep.

For the Dentist — By relieving nervous tension and physical suffering, expedites and facilitates operative work.

LUMALGIN is both an efficient and economical remedy for the relief of Toothache, Headache, Neuralgia in general, and nervousness and sleeplessness associated with pain.

Supplied in Convement Tablets, Tubes of 10 and Bottles of 25. Sample & Literature on request.

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Quick and Economical as well as Convenient

For the dental profession, we have prepared Novocain-Suprarenin Solutions "E" and "T" in ampule form for many years. These solutions are recognized as standard.

Metz N. S. Solutions "E" and "T" are preferred because:

There is assurance that they contain "The Dependable Originals"—Novocain and Suprarenin.

Scientific exactitude is employed in their preparation.

They are isotonic.

They are sterile.

For continuously satisfactory results insist upon Metz N. S. Solutions "E" and "T".

H. A. METZ LABORATORIES, INC.
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DOCTOR

Just a 2-Cent Red Stamp

NOW

Will Save You Not Less Than One Hundred Dollars

We have on hand approximately twenty-five used chairs, all rebuilt and in good condition, the same number of engines, either D. C. or A. C., cord or cable, late model wall bracket type. A variety of cuspidors, renickeled and new tubing. Cabinets and other office equipment, at very attractive prices.

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IF you practice orthodontia exclusively or if your regular work includes it, you will want to have a copy of our new catalogue *For Better Orthodontia*, Second Edition.

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Just a post-card, doctor, and your copy will be sent you.

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Thirty Years Experience

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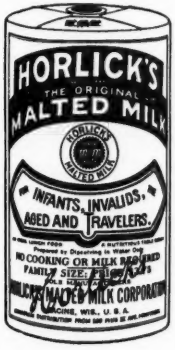

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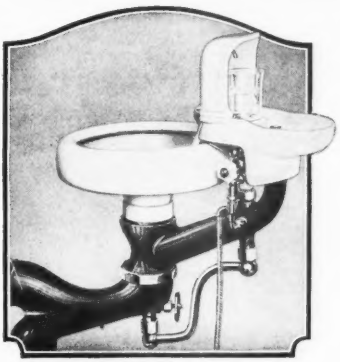

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